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ANALYSIS OF LATERALLY LOADED LONG PILES IN AN INELASTIC SOIL

A THESIS

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NOTATION

Symbol	Description	Units
A	Ratio of the moment to the shear at the ground surface $(M_o\ \beta)/V_o$	
B	Width of the pile	
C	Concentrated angle change	
c	Curvature on distributed angle change	l^{-1}
C_M	Coefficient in the tables for calculating the moment at a point in the pile	
C_q	Coefficient in the tables for calculating the soil reaction at a point in the pile	
C_S	Coefficient in the tables for calculating the soil reaction at a point in the pile	
C_V	Coefficient in the tables for calculating the shear at a point in the pile	
C_y	Coefficient in the tables for calculating the deflection at a point in the pile	
E	Modulus of elasticity of the pile	f/l^2
I	Moment of inertia of the pile cross-section about the axis of bending	l^4
J	Ratio of the slope at the ground surface to the moment at the ground surface $(EI\ \beta)(S_o/M_o)$	
k	Coefficient of horizontal subgrade reaction at a point along the pile	f/l^2
$k_{8.0}$	Coefficient of horizontal subgrade reaction at a distance $\beta x = 8.0$ below the ground surface	f/l^2
L	Length of the pile below the ground surface	l

Symbol	Description	Units
M	Bending moment at a section in the pile	fl
M_o	Bending moment at the ground surface	fl
n	Number of segments in pile	
n_h	Constant of horizontal subgrade reaction	f/l^3
P	Axial load on the pile	f
q	Horizontal subgrade reaction on the pile	f/l
R	Exponent in the equations used to define the variation of k along the pile in the inelastic range	
S	Slope at a point along the pile	
T	Distance, βx, along the pile from the surface to the first point of zero deflection	
U	Exponent in the equations used to define the variation of k along the pile in the inelastic range	
V	Shear at a section in the pile	f
V_o	Shear in the pile at the ground surface	f
x	Vertical distance below the ground surface	l
y	Horizontal deflection of the pile	l
y_o	Horizontal deflection of the pile at the ground surface	l
α	Coefficient relating the lengths L of two piles (L'/L")	
β	Relative stiffness factor = $\sqrt[4]{\frac{K_L}{4EI}}$	

SUMMARY

The laterally loaded pile is a particular case of a beam on a deformable foundation, as represented by the soil surrounding the pile. The fact that the load-deformation characteristics of soils are such that they must be classified as non-linear inelastic materials makes an accurate and logical solution of the problem quite difficult. For many years only arbitrary empirical methods of analysing and designing such piles were available. Only within the last 30 years have improved methods been developed and at the present time only a few of these attempt to approximate the non-linear inelastic behavior of the soil.

A new method is proposed for the analysis of elastic, laterally loaded long piles in a non-linear inelastic soil, whose coefficient of horizontal subgrade reaction in the linear range is zero at the ground surface and increases linearly with depth. Included in this type of soil are sands, normally loaded clays, silts, and highly organic soils.

This new method takes the non-linear inelastic behavior of the soil into account by reducing the coefficient of subgrade reaction at all points from the ground surface down to the first point of zero deflection. The reductions are greatest at points near the ground surface, where the largest deflections occur, and decrease to zero at the first point of zero deflection. No reductions are made at points below the first point of zero deflection since the deflections below that point are quite small and the soil will remain in the elastic range.

The curve for the variation of the coefficient of subgrade reaction at points above the first point of zero deflection is such that it is tangent at the first point of zero deflection to the straight line variation for the elastic soil. This variation yielded results that make the method applicable to load-deformation curves that have portions of the curve with a negative slope. Therefore the loading of the soil at points near the ground surface beyond the ultimate strength of the soil can be taken into account.

This method was developed primarily as a means of predicting the deflections, moments, shears, and soil reactions along the pile length as the applied loads are increased and the soil is stressed further into the non-linear inelastic range. In addition, this method can also be used to predict the "locked in" stresses in the pile that occur when the pile is prevented by the soil from returning to its original undeflected position upon removal of the applied loads.

The method is applicable only to long piles, or piles with a length, βL, greater than four. The length of the piles used in all included solutions is actually eight, but since the behavior of all long piles above the first point of zero deflection is essentially the same, the coefficients can be used for all long piles.

The important assumptions made are that the pile initially be straight and vertical and have a constant cross-section throughout the entire length. Also the stresses in the pile are assumed to remain in the elastic range. When the load is applied, plane sections must remain plane and deformations be small enough so that the usual bending theory remains valid. The soil surrounding the pile is assumed to be homogeneous and isotropic and one whose coefficient of horizontal subgrade reaction in the linear elastic range is zero at the ground surface and increases linearly with depth.

Since the distance from the ground surface to the first point of zero deflection depends considerably on the boundary conditions at the ground surface, as well as the degree of non-linear behavior of the soil, a general solution that covers all possible cases is not possible. Separate solutions must be obtained for each boundary condition and variation of the coefficient of subgrade reaction.

Solutions for this new method were obtained by using a numerical integration procedure, usually referred to as Newmark's method, on a digital computer. Various boundary conditions at the ground surface are considered and for each boundary condition solutions are given for varying reductions in the coefficient of subgrade reaction.

Both statically determinate and statically indeterminate boundary conditions are considered. The statically determinate boundary conditions considered are those where the moment and the shear at the ground surface are either both positive or both negative. Solutions were not considered for statically determinate piles with a moment at the ground surface of opposite sign from the shear at that point.

The statically indeterminate boundary conditions considered are those where the pile is restrained at the ground surface in such a manner that there is a linear relationship between the moment and the rotation at the ground surface. This results in a moment of opposite sign from the shear at the ground surface. Solutions were not considered for statically indeterminate piles that do not have a linear relationship between the moment and the rotation at the ground surface. However the solutions given can be used for the non-linear cases by using trial and error, provided that the moment and shear at the ground surface are determined to be of opposite sign. If the moment and shear are of the same sign, then the solutions given for the statically determinate piles can be used, but trial and error must be used to a greater degree.

The solutions not only provide a means of solving individual problems, but also produce a certain amount of qualitative information regarding the effect of the non-linear inelastic behavior of the soil on the behavior of the pile. The solutions showed that this behavior of the soil increases the magnitudes of both the maximum moment and the maximum deflection. Also it is shown that when using values of the coefficient of subgrade reaction based solely on the deflection at the ground surface, the maximum bending moment can be as much as 50 per cent in error, unless the correct variation of the coefficient of subgrade reaction with depth is used. Also for large values of moment at the ground surface, relative to the shear at that point, this behavior of the soil does not affect the maximum moment by an appreciable amount.

CHAPTER I

INTRODUCTION

The laterally loaded pile is one of many soil-structure interaction problems that have been receiving increasing study in the last 15 years. This increase is due mainly to the construction on pile foundations of many important structures that are subjected to large lateral loads. Also the development of improved methods of testing and analysis has stimulated interest in difficult problems whose solutions previously could only have been roughly approximately.

Examples of structures supported on piles and subjected to lateral loads of significant magnitude are numerous and varied. Buildings must be able to withstand large lateral forces caused by winds. Also any building whose column bases are restrained against horizontal movement will have lateral forces transferred to the foundation. Bridge piers can be acted on by lateral forces due to wind and wave action, as well as the collision of ships. Earthquakes also cause significant lateral forces on both buildings and bridges.

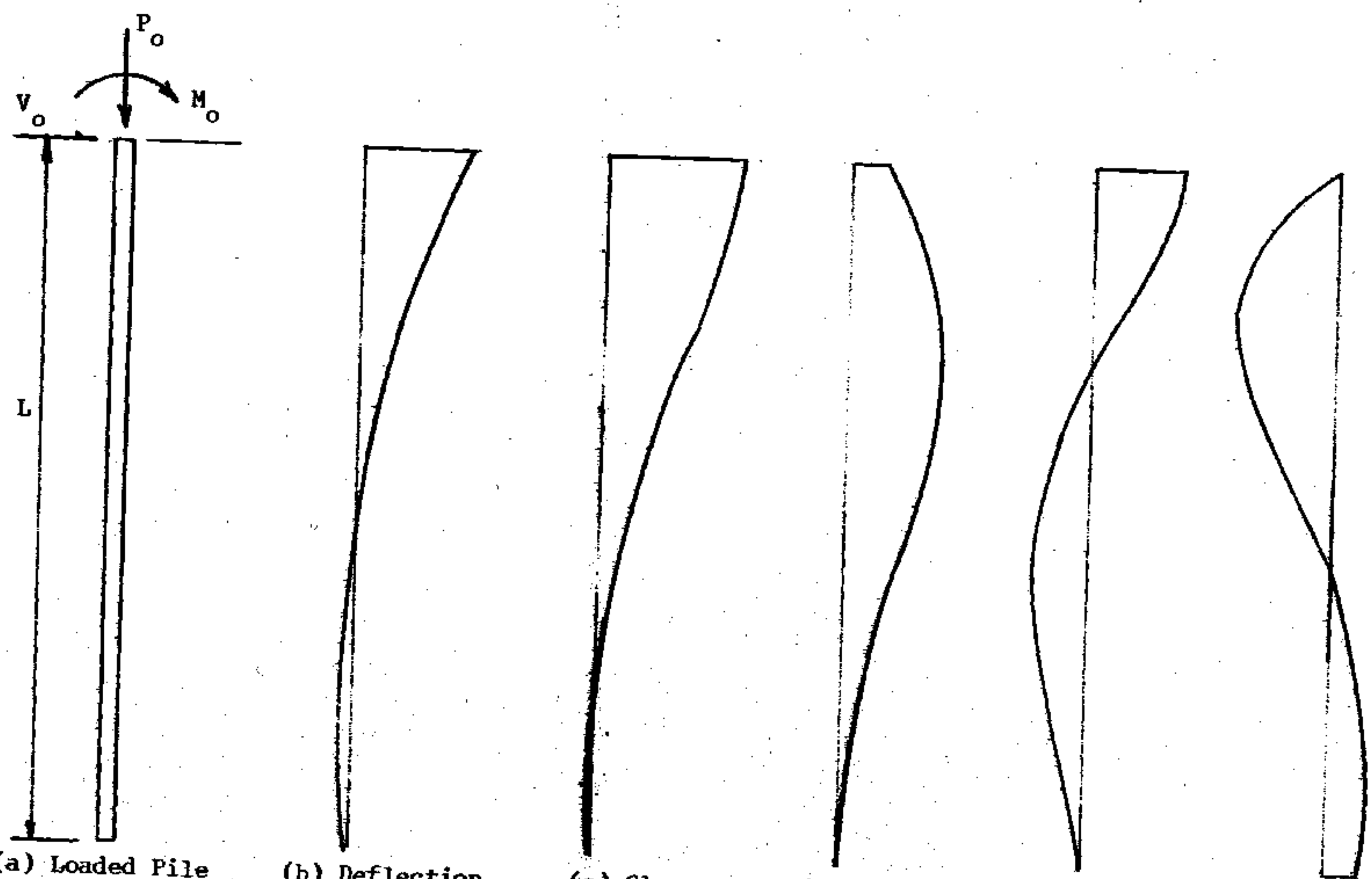
Dams and locks are often supported on piles that must be capable of resisting lateral forces resulting from differential fluid pressure and possibly the impact of moving vessels. Pile supported retaining walls must withstand lateral earth pressures and overturning moments. Radio, television, and electric transmission towers are subjected to significant wind forces.

Probably the most significant example of laterally loaded piles that has been introduced in recent years is to support offshore towers and drilling platforms that are used in oil exploration and drilling, national defense, and navigation. The lateral loads due to wind and wave action on these structures are far more critical in the design of the piles than the vertical loads acting on the structure. Failures of offshore towers have often occurred during severe storms (1,2)[1].

The laterally loaded pile is a particular case of a beam on a deformable foundation. A single vertical pile with a moment, M_o, a horizontal shearing force, V_o, and an axial force, P_o, applied at the ground surface is shown in Fig. 1a. As these loads are applied the pile assumes some deflected shape (Fig. 1b) and the pile is subjected to shearing forces and bending moments at all sections throughout its length (Fig. 1d and Fig. 1e). As the pile deflects, the soil resists the deflection and soil reactions are developed throughout the length of the pile, Fig. 1f. These reactions resist the forces that are applied at the surface and the resultants are in equilibrium with them.

The solution of a beam on a continuous deformable foundation, such as a laterally loaded pile, is greatly simplified if an approximation known as Winkler's hypothesis (3) is assumed to be valid. This assumption is that for a given beam the reaction forces of the deformable foundation at a point along the beam are a function only of the beam deflection at that point. Therefore, the foundation can be repre-

[1]Numbers in parentheses refer to corresponding items in the Bibliography.



(a) Loaded Pile (b) Deflection (c) Slope (d) Moment (e) Shear (f) Soil Reaction

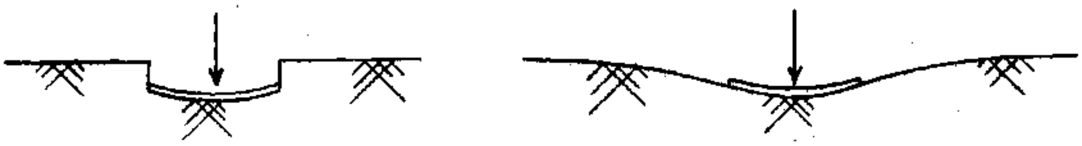
Figure 1. Behavior of a Laterally Loaded Pile

sented as an infinite number of closely spaced springs, each acting independently of the others. The reaction of the soil, q, against the beam at some point is then equal to a coefficient, k, times the deflection, y, at that point. For a given laterally loaded pile the coefficient, k, which is called the coefficient of subgrade reaction, usually varies with both depth and deflection.

The difference between the effect of a short beam on an ideal foundation and its effect on a Winkler foundation can be seen by comparing Fig. 2a with Fig. 2b. The surface of the Winkler foundation would deflect only at those points directly beneath the loaded area, whereas the surface of the ideal foundation would remain continuous with deflections beyond the loaded area.

The Winkler foundation has been widely used in the solution of such problems as the bending of railroad tracks, continuous footings, raft foundations, concrete pavements, and laterally loaded piles. Only a limited number of solutions are available that use the elastic theory that considers the effect on the settlement at a point of the pressures at adjacent points. Some of the examples of the use of the elastic theory can be found in references (4) and (5). The difficulty in obtaining a solution for other than a Winkler foundation is increased even more if the foundation is considered as an elasto-plastic medium instead of an ideal elastic one.

The validity of Winkler's hypothesis has been unquestioned for many years, but recent research has proved its results are quite acceptable. In 1937 Biot (6) justified by theoretical methods the use of this hypothesis in solving for the bending of a beam on elastic



(a) Winkler Foundation   (b) Ideal Foundation

Figure 2. Comparison of Types of Foundations

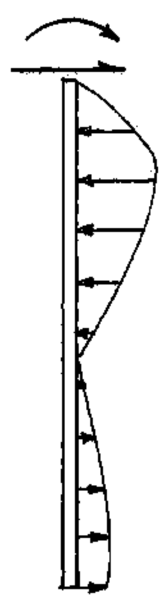


Figure 3. Forces Acting on a Laterally Loaded Pile

foundations. Vesic (7,8) made an experimental investigation of beams resting on a horizontal subgrade and found that the use of Winkler's hypothesis gave very good results for long flexible beams. Barden (9) also made an experimental investigation similar to Vesic's and also concluded that Winkler's hypothesis is satisfactory for flexible beams. The Winkler model will therefore be selected as a reasonable approximation to the actual problem.

Excluding the axial force, the usual forces acting on a laterally loaded pile are shown in Fig. 3. If Winkler's hypothesis is assumed to be a reasonable model and if secondary effects of the axial force are neglected, the differential equation for the pile, according to the theory of bending of beams, becomes

$$EI \frac{d^4y}{dx^4} = q = -k_x y \tag{1}$$

E = modulus of elasticity of the pile

I = moment of inertia about the axis of bending of the pile

y = lateral deflection of the pile at a distance x below the ground surface

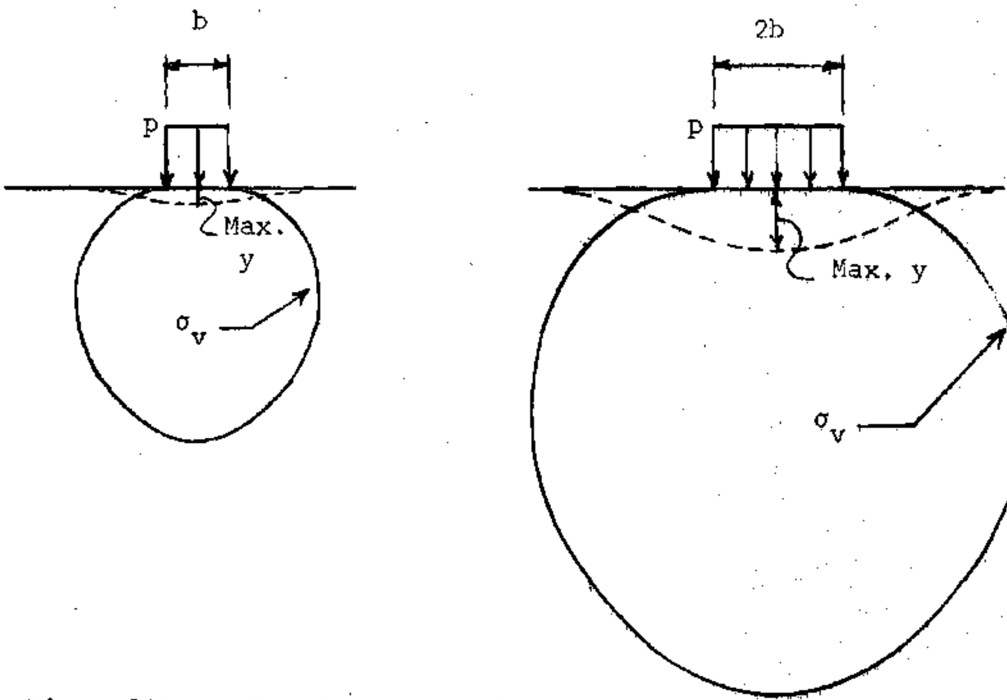
k_x = coefficient of horizontal subgrade reaction at a distance x from the ground surface

The validity of Winkler's hypothesis and the accuracy of the resulting solution for the bending of a given pile depend greatly upon the accuracy of k, the coefficient of horizontal subgrade reaction. The erroneous assumption has been made that the coefficient had a definite value for a particular subgrade. Actually the value of k is not a constant but is a function of many variables. For a given pile the value not only varies along the length of the pile, but also varies with the deflection at each point, since the soil reaction does not vary linearly with the deflection of the pile.

The value of k is influenced by the soil characteristics, the width of the pile, the shape of the pile cross-section, the flexural rigidity (EI) of the pile, and the nature of the loading (static or dynamic).

The width of the pile has a significant influence on the value of k as shown in Fig. 4. If two piles or plates with unequal widths transfer equal pressures per unit area to the soil, the wider pile or plate will have the larger deflection and a corresponding lower value of k. The plate in Fig. 4b has twice the width of the plate in Fig. 4a. If lines of equal vertical stress in the soil mass are drawn as shown in Fig. 4, the wider plate stresses a far larger volume of soil than that of the smaller plate, giving a larger deflection. Since $k = p/y$, the larger plate will have a smaller value of k.

Methods of determining k and the effects of the previously mentioned factors on the value of k have received increased attention in recent years. Terzaghi published a significant paper (10) in 1955. His paper contains a discussion of the factors affecting the coefficient of subgrade reaction. Terzaghi also recommends values of the coefficient for various soils and discusses different methods of determining the coefficient, based on the deflections and rotations of a test pile.



(a) Line of Equal Vertical Stress in Soil for Footing of Width b

(b) Line of Equal Vertical Stress in Soil for Footing of Width 2b

Figure 4. Influence of Width of Footing on Modulus of Subgrade Reaction

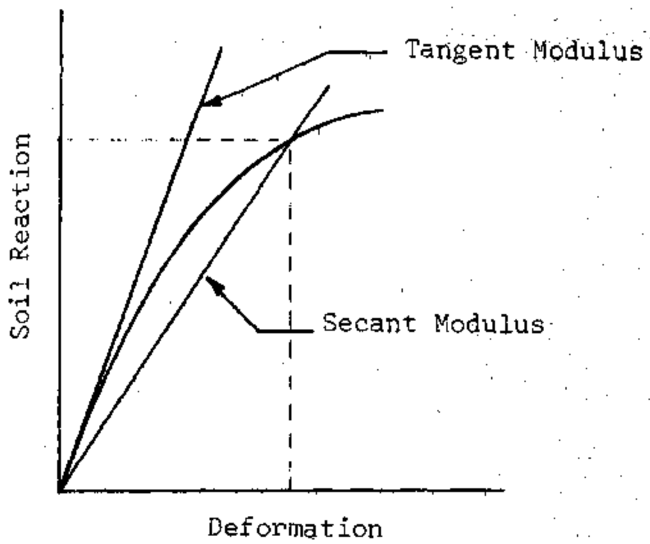


Figure 5. Soil Reaction--Deformation Curve

Vesić has made a notable contribution in several papers (8,11,12) describing the effect of different factors on the coefficient of subgrade reaction and methods of determining the coefficient of subgrade reaction from a test beam or pile. Grandolfi (13) used tests on model piles to study various methods of obtaining k.

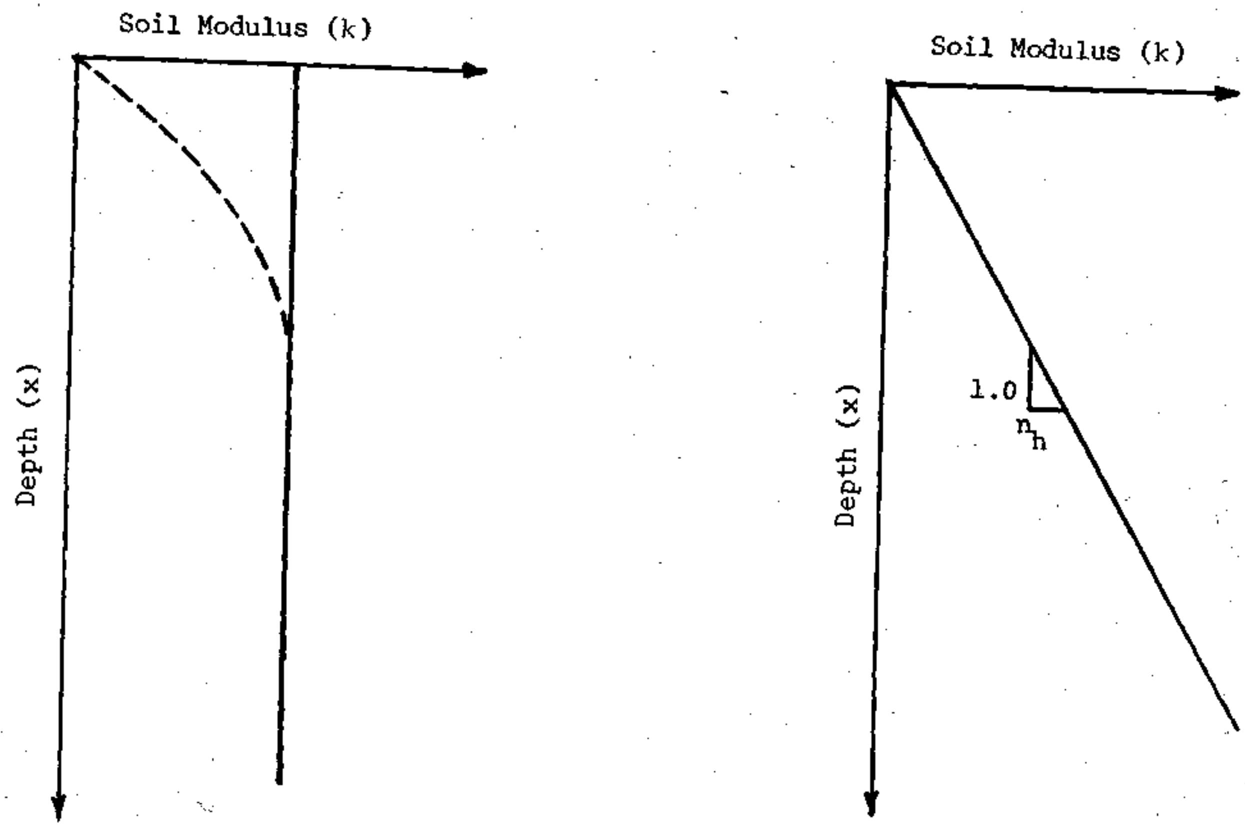
Also Skempton has proposed a method (14) that possibly has some value for laterally loaded piles. McClelland and Focht (15) proposed a method of correlating stress-strain curves from laboratory tests on samples with soil reaction-deflection curves for laterally loaded piles. Davisson (16) gives a summary of many of the existing methods of predicting k, along with a discussion of the factors influencing the value.

For a given pile and a particular loading at the ground surface, the variation of k along the pile length depends on the properties of the soil and the deflection of the pile. A typical soil reaction-deflection curve for a point along the pile is shown in Fig. 5. At small deflections the reaction varies almost linearly with the deflection and the curve can be approximated by a straight line with k equal to the tangent modulus. As the reaction increases beyond approximately 1/4 to 1/3 of the ultimate value, the relationship between the reaction and the deflection becomes more of a curve and k becomes equal to the value of the secant modulus. Hence the value of k for a given point becomes smaller as the deflection increases. The soil pressure will be in the non-linear range near the ground surface where the largest deflections occur. There will be a transition from non-linear to the linear range as the depth below the ground surface is increased.

For a given pile the variation of the elastic k, or tangent modulus, with depth below the ground surface depends primarily on the soil properties. Davisson (16) recommends variations for various types of soils, based upon a thorough review of available information. Terzaghi (10) makes essentially the same recommendations, but does not consider as many types of soil as Davisson does.

Both Terzaghi and Davisson recommend that at a given distance "x" from the ground surface $k_x = k$, where k is a constant, be taken as a good approximation for the variation of the elastic modulus for pre-loaded clays. However, the true variation of k near the ground surface is uncertain. Davisson (16) concludes that the exact variation would be zero at the ground surface and increase with depth, becoming tangent to the line $k_x = k$ at a distance below the ground surface of approximately three times the width of the pile (see Fig. 6a).

The variation of the elastic k, for a given pile in sand, should be very close to the straight line $k_x = n_h x$, where n_h is a constant (Fig. 6b). This value has been recommended by Terzaghi and Davisson, as well as others. The value of k in a sand deposit with a given relative density will be a function of the effective confining pressure and the confining pressure varies almost directly with the distance below the ground surface. Consequently, a linear variation of k with depth is to be expected for sand deposits. Tests on laterally loaded piles in sand deposits have indicated that this is true. The location of the water table would affect this variation, however, since the effective weight of the soil is less below the water table than it is above.



(a) Stiff Clays

(b) Granular Soils and Normally Loaded Clays

Figure 6. Two Most Common Variations of k

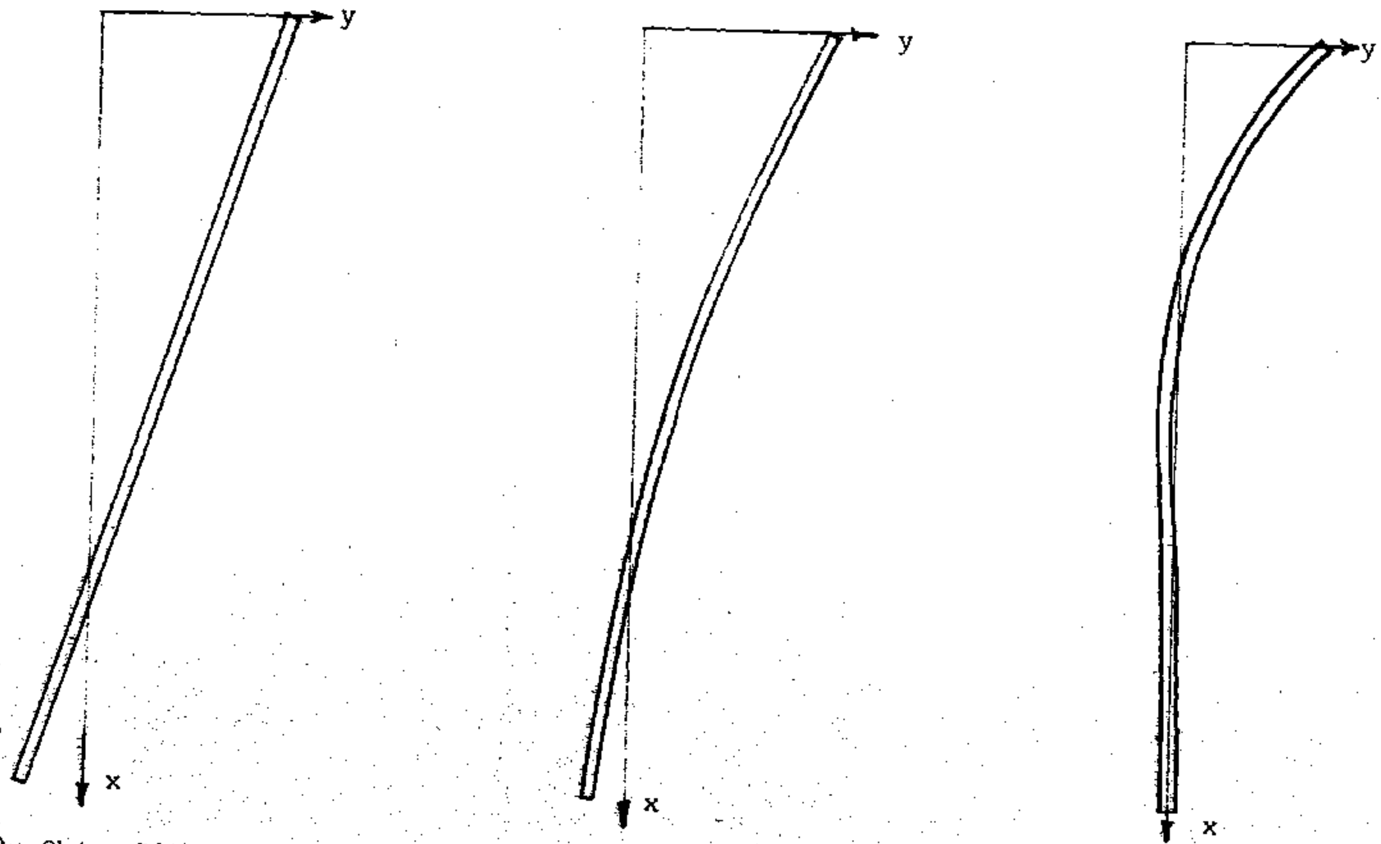
Davisson (16) also concludes that the variation of the elastic value of k for normally loaded clays, silts, and highly organic soils be taken as $k_x = n_h x$.

There will be a reduction in the value of k near the ground surface where the largest deflections occur. This reduction is due to the non-linear behavior of the soil and has a significant effect on the deflection and moment along the pile. However, at small lateral loads the variation of k should be close to that recommended by Terzaghi and Davisson.

For a laterally loaded pile the shapes and magnitudes of the deflection, slope, moment, shear, and soil reaction curves depend on the length and stiffness of the pile and the boundary conditions at the top and bottom of the pile, as well as the load-deformation characteristics of the surrounding soil.

Pile lengths, like all beams on deformable foundations, are usually classified as either short, medium, or long, depending on the length and relative stiffness of the pile to the surrounding soil. Short piles are defined as those whose stiffness is so large compared with that of the surrounding soil that the deflection of the pile due to bending can be disregarded when compared with the deflection of the foundation (Fig. 7a). Therefore, the pile can be treated as an infinitely rigid beam and the deflections, moments, and shears computed accordingly. Detailed information on short rigid piles can be found in references (17), (18), and (19), as well as others.

Long piles are those whose lengths are so great that a load applied at the ground surface has a negligible effect on the deflection,



(a) Short Pile (b) Medium Length Pile (c) Long Pile

Figure 7. Effect of Length on the Deflected Shape of the Pile

slope, moment, and shear near the lower end (see Fig. 7c). The variation and magnitude of the deflection, slope, moment, and shear along a long pile is almost identical to that for a pile with the same cross section, but with an infinite length. Therefore, it can be accurately concluded that increasing the length of the pile beyond a certain distance would have very little effect on the lateral load carrying capacity of the pile. Most piles in actual practice that must resist lateral loads are flexible enough to be classified as long piles.

Piles of medium length have deflections due to bending moments that can not be ignored and also have deflections, slopes, moments, and shears near the lower end that have a significant magnitude (see Fig. 7b). The behavior of piles of medium length ranges from that of short piles to that of long piles, depending on the relative stiffness of the pile to the surrounding soil.

The boundary conditions at the upper end of the pile also have a significant effect on the behavior of the pile. The direction of the moment at the ground surface is determined by these boundary conditions and the direction either increases or decreases the magnitudes of the deflections and moments that would result from a lateral force applied at the ground surface. The moment at the ground surface could be either statically determinate or statically indeterminate.

CHAPTER II

REVIEW OF METHODS OF ANALYSIS AND DESIGN OF LATERALLY LOADED PILES

One of the first methods of predicting the behavior of laterally loaded piles was based on the assumption that the soil resistance was the same as the passive resistance of a vertical wall. However, when actual tests were performed it became evident that the resistance for a pile exceeded that of a wall, as would be expected.

Analyses based on interaction of the pile and surrounding soil were mainly introduced in the 1930's. Some solutions for beams on elastic foundations were developed before then in other countries, but the first important work available in this country was Timoshenko's solution for a beam on an elastic foundation for the special case $k_x = k$ (20). In 1935 Rifaat published the solutions for $k_x = k$ and $k_x = n_h x$ (21). These papers made available solutions for both variations of the elastic soil modulus shown in Fig. 6.

Feagin published a paper (22) in 1937 describing lateral load tests conducted on timber and steel piles that were to support a lock on the Mississippi River. This paper stimulated considerable discussion of methods of predicting the behavior of laterally loaded piles. Chang (23) was the first to use Timoshenko's solutions (20) in the analysis of piles. Cummings (24) proposed a solution based on the assumption that the pile was fixed against rotation and displacement at some distance below the ground surface and assumed some deflected shape between there and the ground surface. He also assumed that $k_x = n_h\ x$ represented the soil resistance. The assumption that the pile is fixed at a certain distance below the ground surface is still used (25).

For variations of k other than those shown in Fig. 6, the solutions of the differential equation for bending of the pile become so difficult that they can best be solved by numerical methods, such as finite difference equations and numerical integration methods. Palmer and Thompson (26) were the first to make use of finite difference equations. Their work took place before digital computers could be used and the simultaneous equations had to be solved by hand or by desk calculators. Hence, the number of equations had to be kept to a limited number and the resulting accuracy of the solution was not as great as can now be obtained. However, the paper was significant since it showed that this method could be used and a solution obtained for any boundary conditions at the top and bottom of the pile, as well as any variation in k_x.

Gleser (27) used finite difference equations to obtain solutions for $k_x = n_h\ x$. One solution was obtained for a pile fixed against rotation at the ground surface and another was obtained for a pile that was free to rotate at the ground surface. The results from these solutions were then compared with results from load tests on piles at another site on the Mississippi. The theoretical results compared favorably with the test results.

Gleser was one of the first to emphasize that since the soil is not an elastic medium the deflections and moments do not vary linearly with the applied lateral load. He concluded that since the soil is an inelastic material and has irreversible deformations, all existing theoretical analyses of laterally loaded piles were unrealistic since they did not consider the inelastic behavior. Since Gleser's paper was published a considerable amount of experimental and theoretical work has been done and the knowledge of the behavior of laterally loaded piles has increased substantially. However, the use of a linearly elastic soil system can still be found in many recent papers.

The construction of offshore towers, especially those used in the oil industry, called for an increase in the understanding of the behavior of laterally loaded piles. These towers are supported entirely on vertical, or near vertical, steel pipe piles and are subjected to large lateral loads caused by wind and wave action. Since the failure of one of these towers would result in a large loss of time and money, as well as human lives, an extensive research program was undertaken by the oil industry.

Most of the research work connected with offshore construction has been done at the University of Texas by Hudson Matlock and Lymon Reese. They used the method of finite differences, developed by Palmer and Thompson and later used by Gleser. However, Matlock and Reese made use of a digital computer to solve the simultaneous equations and consequently were able to obtain results with a high degree of accuracy, probably to about three significant figures, by dividing the pile into a large number of short segments. Descriptions of the methods used by Matlock and Reese can be found in references 28, 29, 30, 31, and 32.

It is possible, as Matlock and Reese have done, to write a program for a digital computer that will solve the differential equation for bending of a laterally loaded pile for any boundary conditions at the top of the pile, as well as any variation of k and cross-section of the pile, by using numerical methods.

Matlock and Reese have also developed the only non-computer method that has been available for analysing an elastic laterally loaded pile in a non-linear non-elastic soil (33). This solution is essentially one of trial and error and has been used extensively in the design of offshore drilling towers. Soil resistance-deflection curves similar to the one shown in Fig. 5 are obtained for various depths below the ground surface. The variation of k with depth is assumed to be linear, as shown in Fig. 6b. Various values of n_h are tried and the deflections and soil reactions at points along the pile and near the ground surface are computed. The value of n_h that best approximates the true soil reaction-deflection curves is used for that particular load. This solution is quite laborious, particularly for piles whose moment at the ground surface is statically indeterminate.

Also a linear variation of k with depth is frequently a poor approximation of the true variation. As the lateral load on a given pile is increased, the deflections become larger than they would be for a linear soil, giving reductions in the values of k. In using this method, if the value of k at a certain point is reduced by a given proportion, it must be reduced by the same proportion throughout the length of the pile. The true behavior is such that the largest reductions in k occur near the ground surface where the largest deflections take place.

The reductions in k for depths below the first point of zero deflection are very small, for the pile deflects very little below that point. Therefore, the soil behavior is non-linear and non-elastic near the ground surface and becomes linearly elastic at some distance below.

In spite of these limitations, this method does give approximate answers which previously could not be obtained at all for laterally loaded pile problems. Also a certain amount of qualitative information can be obtained by approximating the non-linear behavior of the soil by varying n_h.

One of the most thorough compilations of the available material on the behavior of laterally loaded piles is Davisson's doctoral thesis (16). It contains a review of previous experimental and theoretical work, as well as the results of Davisson's theoretical investigation of the secondary effects of the axial load on the bending of the pile. Davisson solved the differential equations by means of an analog computer rather than the use of numerical methods.

Davisson limited his investigation to variations in the soil modulus of $k_x = k$ and $k_x = n_h x$. Piles that were free from restraint at the ground surface were considered, as well as those that were fixed against rotation at the ground surface. The results were given in the form of curves. The pile buckling loads were calculated for the various conditions of restraint and the deformations of the piles after buckling were shown. It was assumed that the axial load was constant along the length of the member; an assumption that would be on the safe side. The effects of axial loads of various magnitudes on the deflection, moment, and soil reaction along the pile length are shown.

Davisson concluded that the effect of the axial force on bending of the pile can usually be ignored for piles that are fixed against rotation at the ground surface, for the critical buckling load is approached before secondary effects become a significant factor. Secondary effects due to axial loads can become an important factor for piles that are not fixed against rotation at the ground surface, in some cases for axial loads that are as low as 20 per cent of the critical buckling load.

Later Davisson and Gill published an extension of Davisson's thesis (34), analysing the behavior of laterally loaded piles in a two-layered soil system. The piles were long enough to be considered as flexible. The thickness and strength of the top layer of soil, with respect to the lower layer, were varied over a wide range, for piles that were free to rotate at the ground surface, as well as those that were fixed against rotation at the ground surface. The resulting deflections and moments were shown in the form of curves. The results clearly show that the properties of the soil near the ground surface determine the behavior of the pile. Even a thin layer of soil near the ground surface with a strength considerably different from the underlying soil has a significant effect on the maximum deflection and moment in the pile.

Broms has developed methods to predict both the deflection at working loads and the ultimate load capacity for laterally loaded piles (35,36). The applicability of this method is restricted since it is applicable only to piles that are either free to rotate at the ground surface or absolutely fixed against rotation at the ground surface. Also the method of calculating the deflection at working loads is based on the assumption that the soil behaves as an ideal linear material. Therefore, solutions for piles that are either restrained, but not fixed, against rotation at the ground surface or that stress the soil beyond the linear range at working loads could not be obtained using this method.

While load tests on flexible piles have given considerable information as to the effect of a non-linear soil on the behavior of the pile, no theoretical analysis has been developed or presented which showed the effect of stressing the soil further into the non-linear range near the ground surface, while the soil remained elastic at depths below the ground surface. Theoretical solutions have been developed for various variations of k along the pile length, but none of these have been complete enough to adequately describe the true soil behavior. Some of these solutions could be used for the analysis of a given pile due to a given load, but they would not be accurate enough for a change in load or continued plastic deformation near the ground surface at a constant load. When a pile is loaded and then unloaded, it does not always return to the original undeflected shape and a residual moment is left in the pile. No theoretical method of predicting this moment has yet been presented.

Many of the lateral load tests have given little, if any, useful information. Poor testing and loading procedures have often been used. Frequently the significant properties of the soil were not obtained, as the primary objective of the test was to prove that the pile could safely resist a certain load. Since the two most commonly assumed variations of k are $k_x = k$ and $k_x = n_h\, x$, the results of actual tests were usually compared with the solution for one of these variations, while the true variation in the nonlinear range may be considerably different. However, several tests in recent years have given a considerable amount of qualitative information. This has been due to improved testing equipment and procedures, as well as a better understanding of the more significant factors affecting the pile behavior.

CHAPTER III

PROPOSED METHOD OF ANALYSING LONG PILES IN A NON-LINEAR INELASTIC SOIL WHOSE ELASTIC SOIL MODULUS INCREASES LINEARLY WITH DEPTH

Basis for Proposed Method

The assumption that the soil surrounding a laterally loaded pile behaves as an elastic medium has long been recognized as erroneous (33). Only the lack of suitable methods of analysis which consider the non-linear behavior of the soil has kept the linear methods from being discarded entirely. At the present time the only non-computer method that takes into account the non-elastic behavior of the soil available is the approximate method proposed by Matlock and Reese (33). It is hoped that this new method will make a significant contribution to the subject of laterally loaded piles and will stimulate some new thoughts and research in this area.

The method proposed is applicable only to long flexible piles in soils whose coefficient of subgrade reaction, k, in the elastic range is equal to n_h x, where n_h is a constant with depth. According to Davisson (16) this includes sands, gravels, normally loaded clays, normally loaded silts, and possibly highly organic soils. Tests which indicated this variation for sands are described in references 22, 27, 37, 38, 39, and 40. Those for clays can be found in references 41, 42, and 43, and 44 gives results for silts.

As stated earlier, piles whose lengths are great enough that the pile can be classified as long or flexible, have almost exactly the same deflection, slope, moment, and shear at sections between the ground surface and the first point of zero deflection as those for a pile of infinite length. Therefore, non-dimensional coefficients can be derived for the bending of a long pile of a given length and can be used to solve for the bending of any other long pile. To make the calculation and presentation of these non-dimensional coefficients as simple as possible, these coefficients are expressed in terms of the value of k at the bottom of the pile, rather than n_h. If a pile has a length L, the variation of k along the pile will be

$$k_x = \left(\frac{x}{L}\right) k_L = \left(\frac{\beta x}{\beta L}\right) k_L = n_h \, x \tag{2}$$

where k_L is the value of the subgrade reaction at the bottom of the pile.

To further simplify the calculation k_L is used to calculate β, where β is defined as

$$\beta = \sqrt[4]{\frac{k_L}{4EI}} \quad \text{(1.0/length)} \tag{3}$$

All of the coefficients given in the Appendices are for a pile with a length $\beta L = 8.0$. As Matlock and Reese (29), as well as Davisson (16), have shown, all piles longer than a certain length can be classified as long piles. For piles in a soil whose coefficient of subgrade reaction increases linearly with depth this length is approximately

$\beta L = 4.0$. Therefore, the coefficients in the tables can be used for all piles with a length, βL, greater than 4.0.

In analysing a long pile whose length, βL, is different from 8.0, the length, nevertheless, is assumed to be 8.0. The relationship between the lengths of two piles, with a length ratio, $\alpha = (\beta'L')/(\beta''L'')$, can be seen from Fig. 8. Or expressed algebraically,

$$\alpha = \frac{\beta}{\beta''L''} = \sqrt[4]{\frac{k'}{k''}}\ \left(\frac{L'}{L''}\right) = \left(\frac{L'}{L''}\right)^{\frac{5}{4}} \qquad (4)$$

The values of the ratio L'/L'' for various values of α are given in Table 1. These ratios can then be used to find the distance to $\beta L = 8.0$.

As the lateral load on a pile in a soil whose linear subgrade modulus varies as $(\beta x/\beta L)(k_{\beta L})$ is increased, there will be a range, however small, where the soil behaves both linearly and elastically throughout the entire length of the pile. The variation of k is then represented by curve I in Fig. 9. As the lateral load is increased the soil near the ground surface is stressed beyond the linear elastic range. Then k no longer varies linearly along the length of the pile, as shown in curve I, but varies similar to curve II in Fig. 9. In this range the secant modulus is used to describe the coefficient of subgrade reaction, rather than the tangent modulus. As the lateral load is increased still further, there is a further reduction in k near the ground surface, as shown by curve III in Fig. 9.

The deflections at points below the first point of zero deflec-

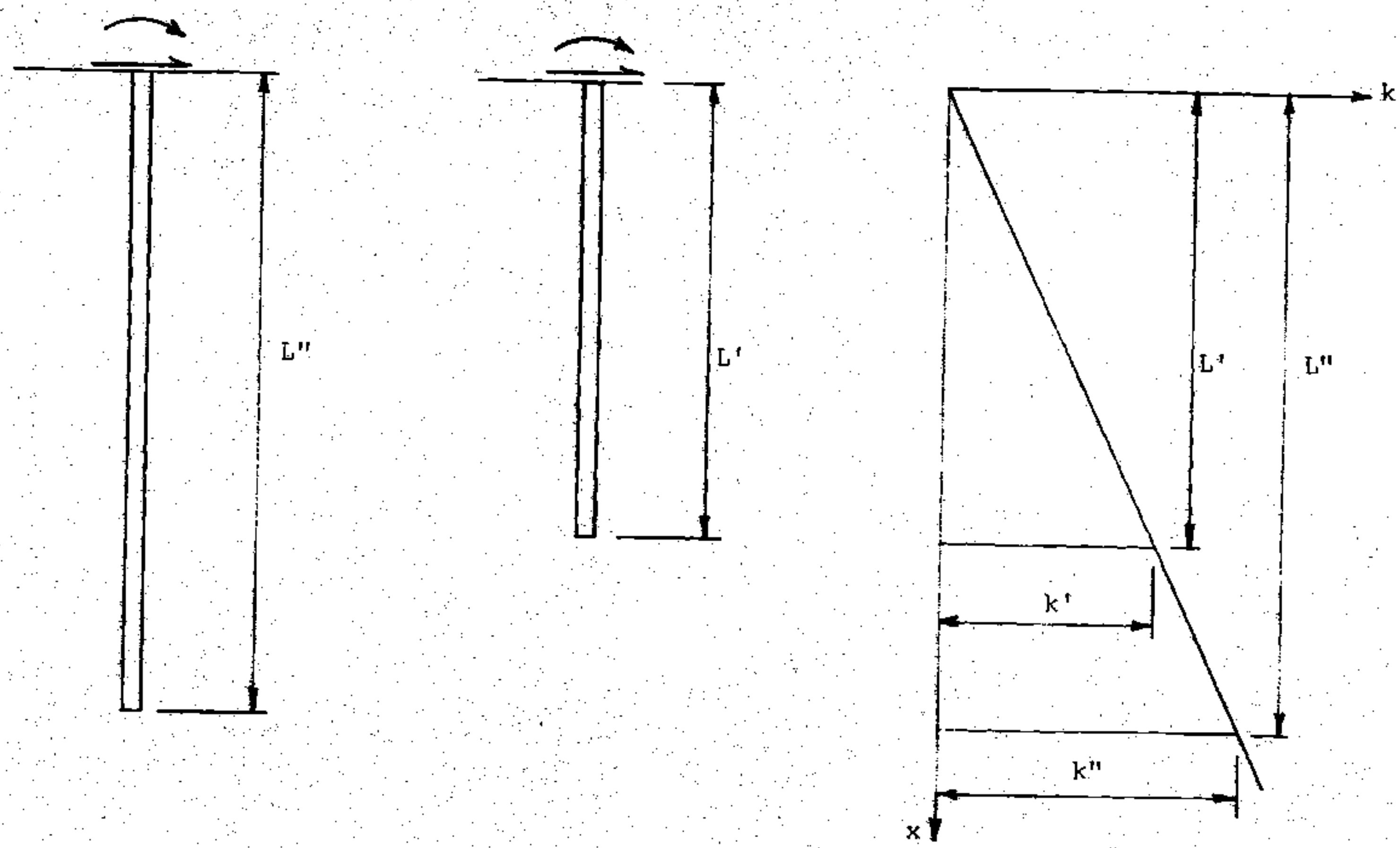


Figure 8. Comparison of Piles of Unequal Lengths

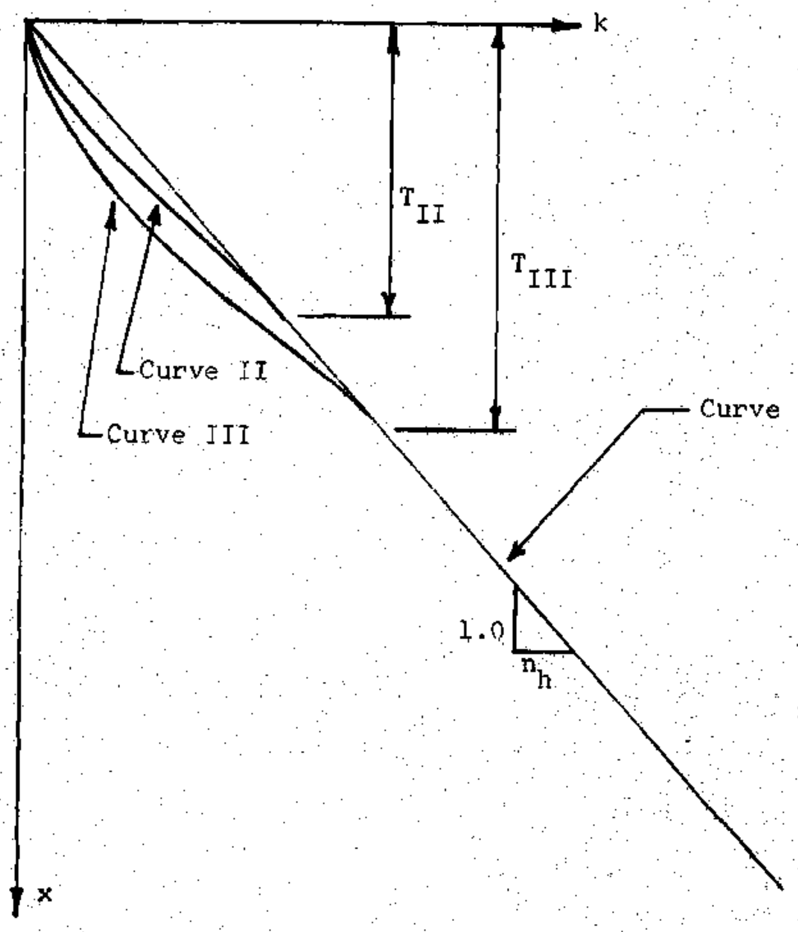


Figure 9. Variation of k with Depth for Elastic and Non-linear Inelastic Behavior

tion are so small compared with those above this point that it is doubtful if any significant reduction in k takes place below this point. Therefore, it was assumed that the soil below the first point of zero deflection behaves elastically, regardless of the magnitude of the applied load.

The variation of k above the first point of zero deflection will depend on the properties of the soil, the magnitude of the applied lateral load, and the nature of the lateral load (static or dynamic). It is logical to expect the greatest reductions in the value of k at points nearest the ground surface and the smallest reductions at points near the first point of zero deflection. Curve II and curve III should be tangent to curve I, in Fig. 9, at or near the first point of zero deflection. Therefore, the following equations for the values of k for points above the first point of zero deflection were chosen,

$$k = [1.0 - (1.0 - \beta x/T)^R]\ (\beta x/8.0)k_{8.0} \tag{5}$$

$$k = [1.0 - (1.0 - \beta x/T)^R]\ [1.0 - (1.0 - \beta x/T)^U]\ (\beta x/8.0)k_{8.0} \tag{6}$$

T = the distance from the ground surface to the first point of zero deflection (dimensionless)

R and U = a variable which decreases as the lateral load and inelastic behavior increase.

The curves represented by Equations (5) and (6) are tangent to the straight line, $k = (\beta x/8.0)k_{8.0}$, at $\beta x = T$, and give the greatest reductions in k at points near the ground surface, as would be expected. The author concedes that this variation will not be exact for all soils, but solutions are given in the tables for enough values of R and U to give results that are reasonably good for most soils whose modulus of subgrade reaction at low stress varies linearly with depth. A decrease in k near the ground surface is obtained by reducing the value of R or U.

For different boundary conditions at the ground surface, tables of coefficients are given for determining the deflection, slope, moment, shear, and soil reaction at points along the length of the pile. For each boundary condition, solutions are given for five or six values of R and U, with the deflection at the ground surface for the lowest value of R or U approximately twice what the deflection would be if the soil had remained in the linear range. This range of values should cover most practical cases.

The main assumptions made in this solution are:

1. The length of the pile is such that the pile can be considered as flexible.

2. The coefficient of subgrade reaction in the linear range is zero at the ground surface and increases linearly with depth.

3. The pile is initially straight and vertical.

4. The stress in the pile is always within the linear range.

5. Plane sections in the pile before bending remain plane after bending.

6. The rigidity of the pile, EI, is constant throughout the pile length.

7. The effect of the axial load and shear on the pile deformation can be neglected.

8. The pile deflections are small enough that the elementary theory of bending can still be considered as valid.

9. The soil behaves linearly below the first point of zero deflection.

A direct solution for the differential equation for bending of a laterally loaded pile can be obtained for the special case where k is constant throughout the length of the pile. Tables for various boundary conditions for this special case can be found in references 20 and 45. For a variation as difficult as that given by Equation (5), a numerical solution is the only means available. There are several other numerical methods available for solving this type of problem in addition to the method of finite difference equations. This particular method has had the most extensive use, but other methods have been proposed by Popov (46), Levinton (47), Newmark (48), and Biezeno (49).

The method selected is the numerical method originally developed by Newmark (48), which is essentially a method of numerical integration usually designated as Newmark's method. This method can be used to find the deflections, slopes, moments, and shears, along beams with various boundary conditions and can also be used to calculate the buckling loads for structural members. There are several variations of Newmark's method, but the method used by the author is almost identical to that described in a paper by Malter (50). This method was selected over the method of finite differences because it required considerably less storage space in the digital computer and also the boundary conditions were easier to describe than they would be in the finite difference method.

The sign convention used throughout is shown in Fig. 10. This is the sign convention that is used in most beam problems, except that the beam or pile is rotated clockwise through an angle of 90 degrees.

Newmark's method for beams on Winkler foundations is essentially one of trial and error. A deflected shape of the beam or pile is assumed and from this shape a better one is computed. This process is repeated until the difference between the assumed shape and the computed shape is sufficiently small to stop calculation. A repetitive process such as this is ideal for computer programming. All solutions were obtained on a Burrough's 220 digital computer.

The lengths of the piles in this dissertation are expressed as $\beta L = 8.0$. This length was divided into 320 equal segments. Actually the pile was divided into two equal parts, each with a length of $\beta L = 4.0$, as shown in Fig. 11. This was necessary since Newmark's method does not converge for piles beyond a curtain length (51)(52) unless modifications are made.

Also by dividing the pile into two halves, a considerable amount of time was saved. The effects of a unit shear and unit moment on the lower half were obtained. Then in the actual solutions of the piles for various boundary conditions at the ground surface and variations in k along the length of the pile only the deflected shape of the upper half needs to be considered. The effect of the lower half becomes simply a boundary condition at the lower end of the upper half. The moment and

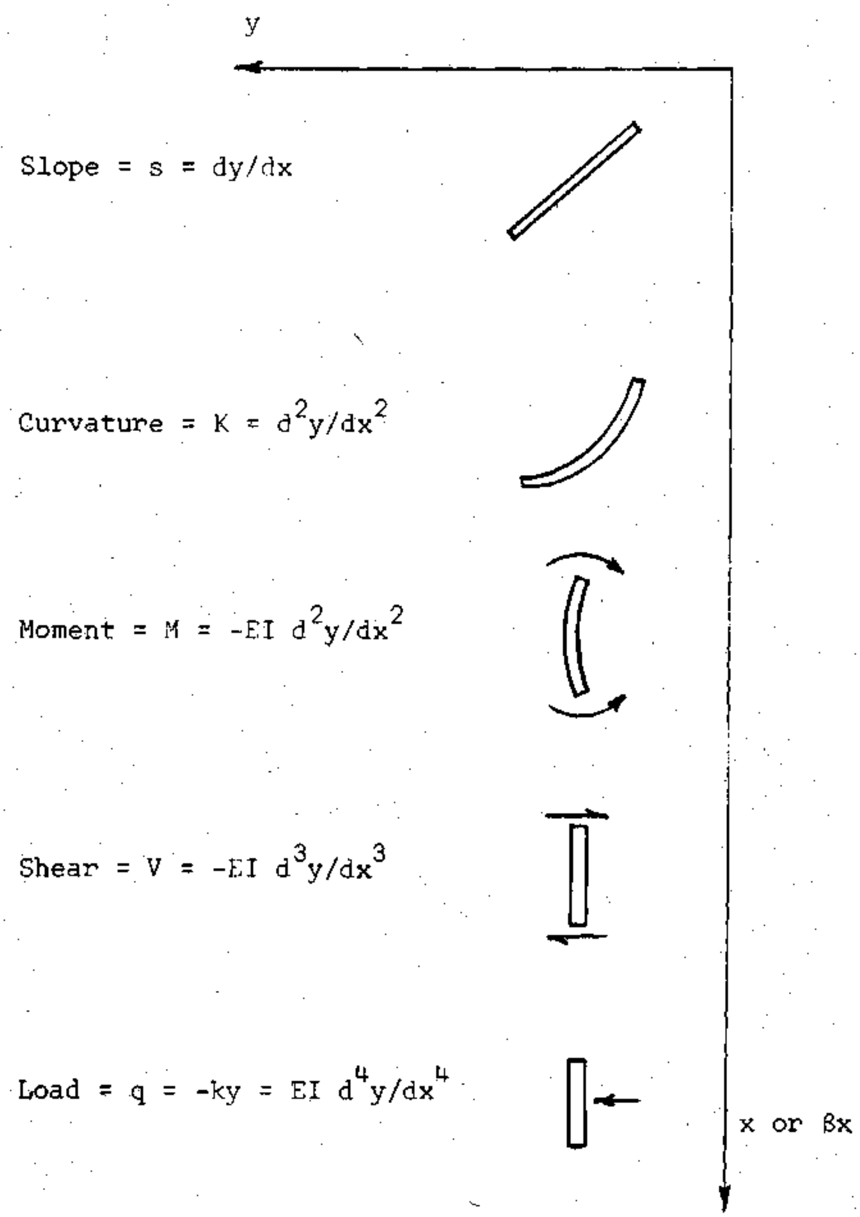
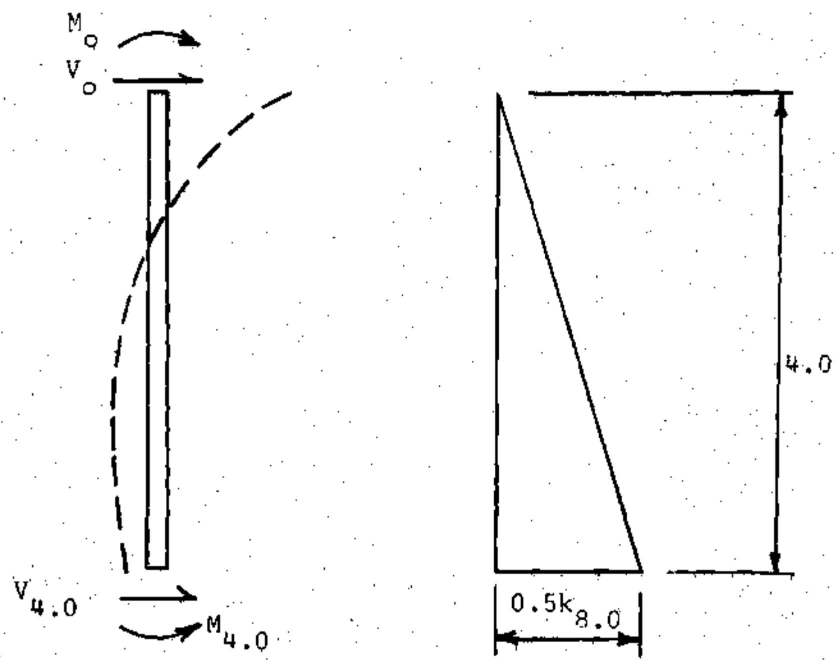
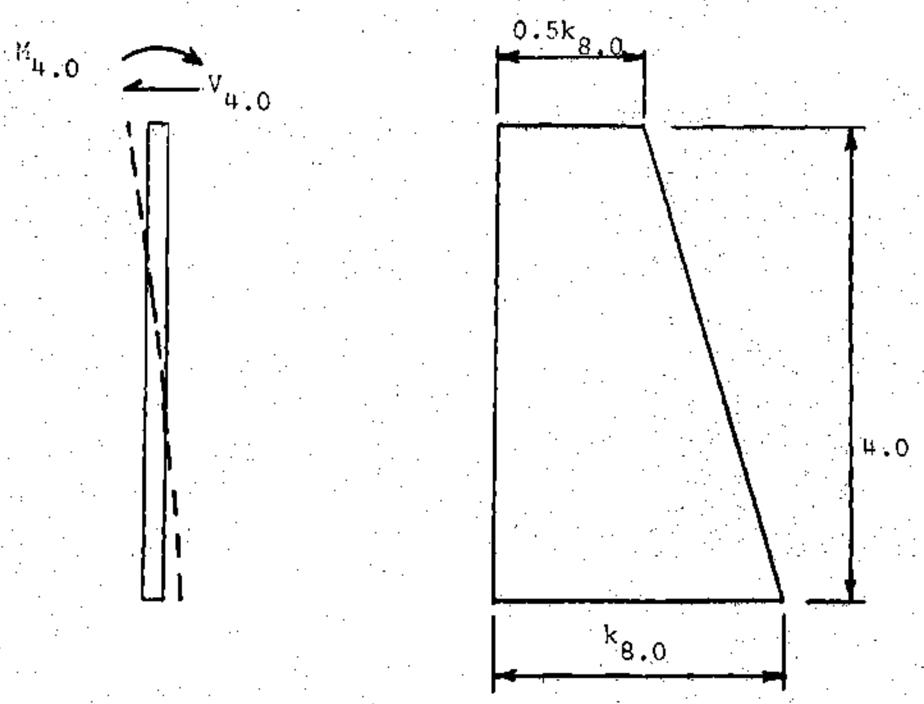


Figure 10. Sign Convention Used in Pile Analysis



(a) Upper Half of Pile



(b) Lower Half of Pile

Figure 11. Division of Pile into Two Parts

shear at $\beta x = 4.0$ must be such that the deflection and slope at that point must be equal for both the upper half and the lower half (see Figure 11).

In using Newmark's method for beams on deformable foundations four coefficients must be computed before the actual trial and error procedure is started. These coefficients are the moment and shear at the bottom of the pile due to a unit rotation of the pile and the moment and shear at the bottom of the pile due to a unit horizontal displacement of the pile. These coefficients are necessary since the deflected shape of the pile must be such that the boundary conditions are satisfied. A deflected shape is assumed and if it does not yield results that satisfy the required boundary conditions, the pile is given an additional uniform displacement and a rotation so that the final deflected shape will satisfy the required boundary conditions.

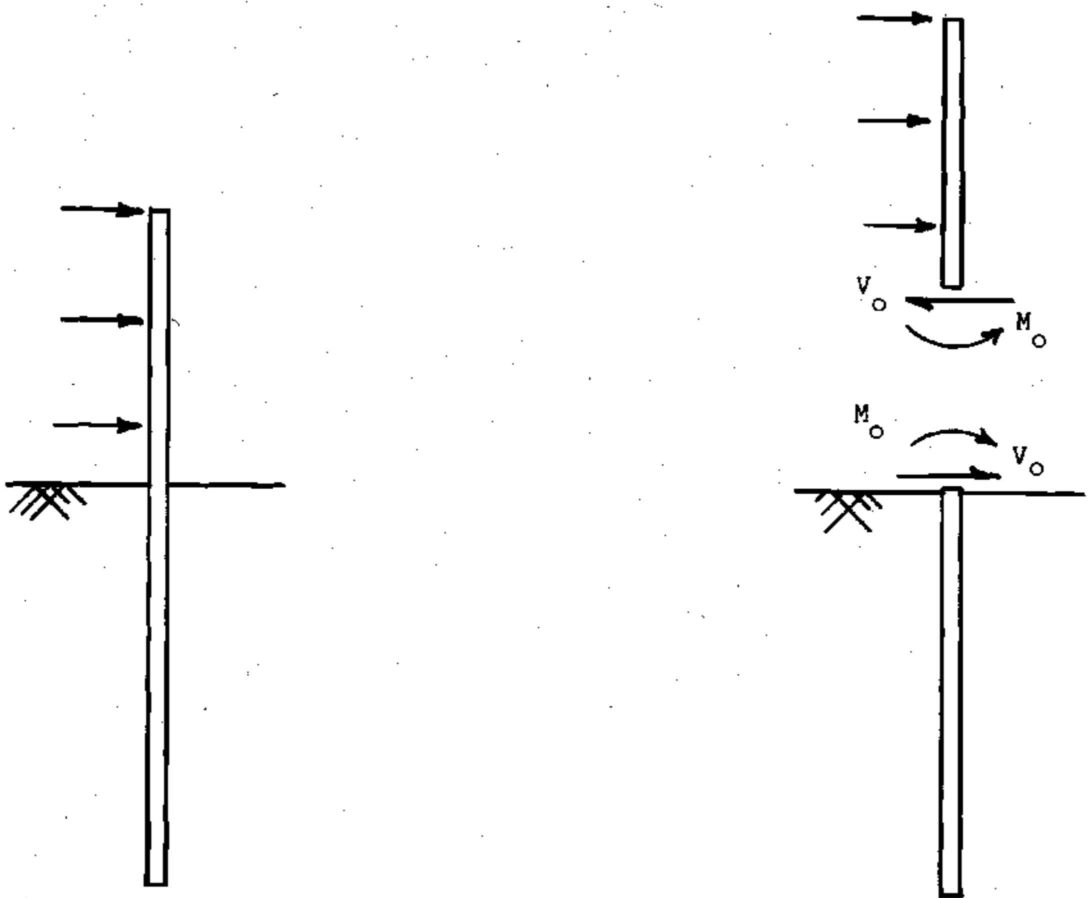
The boundary conditions used in solving for the lower half of the pile are, first, a unit positive moment at the top and zero shear and then a unit positive shear and zero moment at the top of the lower half; with zero moment and zero shear at the lower end for both sets of boundary conditions at the top. The slopes and deflections at the upper end due to this unit moment and unit shear are used in describing the boundary conditions at the lower end of the upper half.

The boundary conditions at the ground surface, or top of the upper half, can result in either a statically determinate or statically indeterminate moment applied at that point. This moment can be either positive (clockwise) or negative (counterclockwise), for a given positive shear applied at that point. All tables given are in terms of a unit positive shear applied at the ground surface, with the exception of Tables 39 through 44. The coefficients in Tables 39 through 44 are in terms of a unit positive moment applied at the ground surface.

The moment at the ground surface due to this unit shear would be statically determinate if the structure above offered no restraint against rotation of the pile at the ground surface. The most common example of this type of structure would be a free standing flag, or communications, pole as shown in Fig. 12a. If the moment and shear at the ground surface are positive and are statically determinate, the boundary conditions will be classified as Type I. This would include almost all piles with a statically determinte moment at the ground surface, since a negative determinate moment and a positive shear would be a rare combination. The relationship between the moment to the shear at the ground surface for piles with Type I boundary conditions is expressed by the following equation,

$$A = \frac{M_o}{V_o} \beta \tag{7}$$

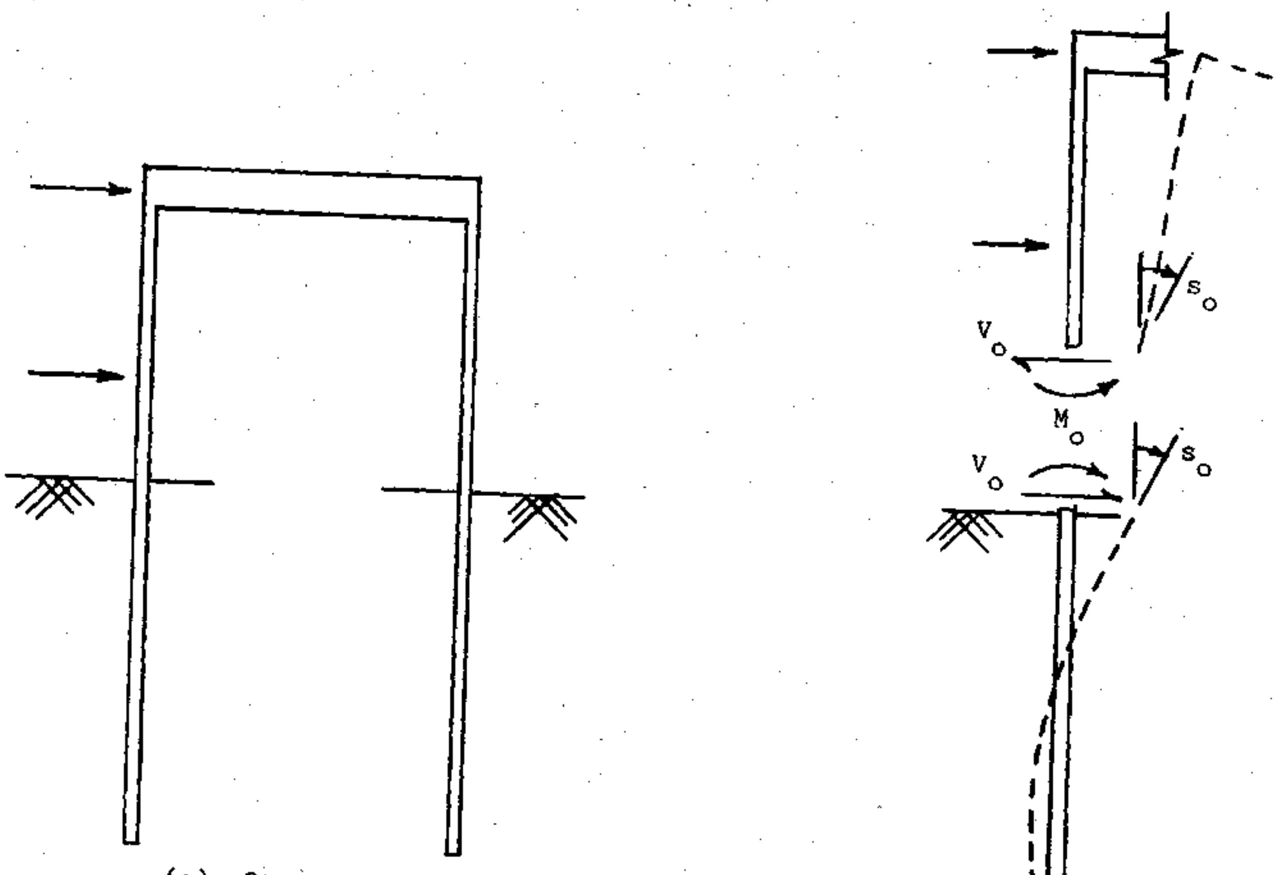
Type II boundary conditions at the ground surface are defined as those which occur if the structure above the ground surface restrains the pile against rotation at that point, and where the horizontal loads are transmitted mainly by shear through the structure above. For these boundary conditions, the shear and the moment at the ground surface are statically indeterminate. The moment can be either positive or negative, depending on the construction of the structure above. Fig. 13a shows a typical structure of this type. Many wharves, piers, and frame build-



(a) Loaded Pile

(b) Internal Forces at Ground Surface

Figure 12. Pile with Type I Boundary Conditions



(a) Structure

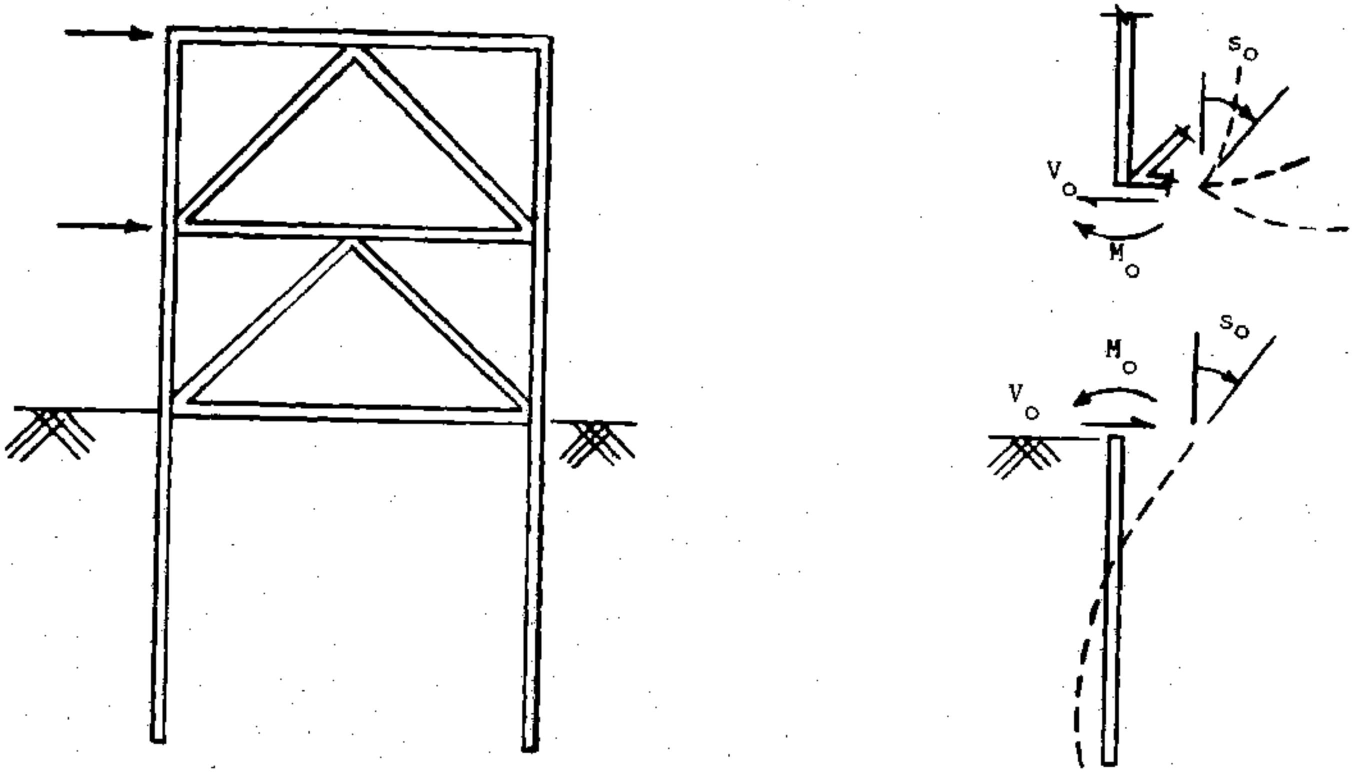
(b) Conditions at Ground Surface

Figure 13. Structure with Type II Boundary Conditions

ings are constructed like this. The moment at the ground surface is determined from the compatibility equation that expresses the continuity of the pile and structure at that point. The slope at the ground surface for the structure above must equal the slope there for the pile, as shown in Fig. 13b. If the column above is flexible compared with the top girder, the moment at the ground surface will be positive. Most frames of this type would have positive moment. However, if the column is stiff, as well as the girder, a negative moment would result at the ground surface.

Due to the many possible combinations of loadings and stiffnesses for the structure above, it is impossible to express the boundary conditions for Type II in general terms and develop corresponding tables for bending of the pile. For this reason, tables are presented in this dissertation primarily for boundary conditions of Type I and Type III, however, these tables can be used to obtain solutions for boundary conditions of Type II.

Fig. 14a shows a structure similar to many which are used in offshore construction. In structures of this type the horizontal load applied to the structure above is transmitted through the structure by axial forces in the members, rather than by shear. The moment at the ground surface is statically indeterminate and is obtained by considering that the slope in the structure above at that point must be equal to the slope in the pile, as shown in Fig. 14b. Therefore, the boundary condition is the same as for Type II, but the moment at the ground surface for Type III will be negative and will vary between zero and the moment for a pile completely fixed against rotation, depending on the



(a) Structure

(b) Conditions at Ground Surface

Figure 14. Pile with Type III Boundary Conditions

stiffness of the structure above. Type III boundary conditions can be expressed best by the ratio of the slope at the ground surface to the moment at that point. This ratio is defined as

$$J = (S_0/M_0)(EI\beta) \qquad (8)$$

Piles that are embedded in massive structures such as dams and retaining walls will also have a negative moment at the ground surface, and the boundary condition can usually be expressed by Equation (8). If the structure above is quite massive, the moment should approach that for a pile completely fixed against rotation at the ground surface.

The boundary conditions at the bottom of the upper half of the pile are indeterminate. As stated earlier, the moment and shear at this point must be such that the deflection and slope at this point are the same for both the upper and lower halves.

Numerical Integration Procedure

All of the solutions were obtained on a Burrough's 220 digital computer. The input or conditions that varied were the boundary conditions at the ground surface, and the variation in k along the pile.

In Newmark's method of numerical integration, the beam or pile length is first divided into "n" number of panels, usually of equal length (see Fig. 15a). These panel lengths do not necessarily have to all be the same length, but having them the same length makes the calculation easier. If the pile is divided into "n" number of panels, there will be "n + 1" panel points, counting the points at the top and the

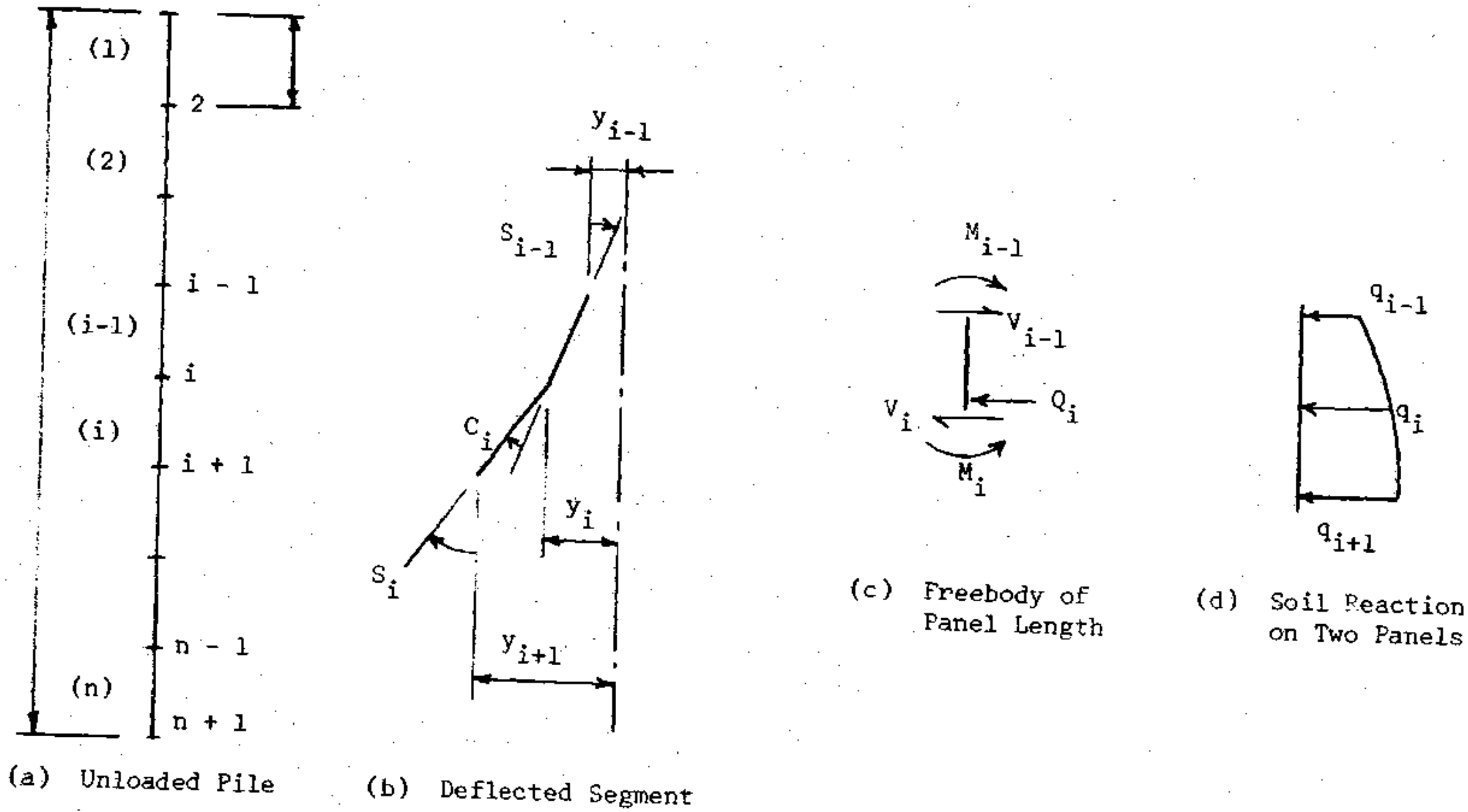


Figure 15. Notation Used for Numerical Integration Procedure

bottom of the pile. A panel point "i" will have panel "i - 1" just above and panel "i" just below, if the top of the pile is taken as panel point "1."

In Newmark's method the distributed soil reaction forces are replaced by concentrated soil reaction forces that act on the pile at the panel points. This results in a constant shear across a given panel. Similarly, the distributed angle change (d^2y/dx^2) is replaced by concentrated angle changes at all panel points. This also means that the slope across a given panel will be constant. Since the values for the shear and slope in the tables are for the panel points, the final shear and slope at a panel point "i" were taken as the average of the shears or slopes in the panels "i - 1" and "i."

The variables for each pile that were necessary for the solution were the boundary conditions at the top of the pile, the variation in k along the pile, and the shears and moments at the bottom of the pile due to a unit displacement and a unit rotation of the pile. For particular values of these factors, the steps in the actual solution are as follows:

1. Assume a deflected shape of the pile.

2. Calculate the distributed load due to the soil reaction at the panel points along the pile, using the equation

$$q = -k\ y \tag{9}$$

3. Calculate the concentrated soil reactions at the panel points. These concentrated soil reactions replace the distributed soil

reactions as shown in Fig. 15d. If the variation on the distributed load is assumed to be parabolic, the equations for the concentrated soil reactions as developed by Newmark are

$$Q_1 = (1/24)(\beta L/n)(7q_1 + 6q_2 - q_3) \tag{10}$$

For i of from 2 through n

$$Q_i = (1/12)(\beta L/n)(q_{i-1} + 10\, q_i + q_{i+1}) \tag{11}$$

$$Q_{n+1} = (1/24)(\beta L/n)(7\, q_{n+1} + 6\, q_n - q_{n-1}) \tag{12}$$

4. Calculate the shears between the panel points along the pile (see Fig. 15c) using the equation

$$V_i = V_{i-1} - Q_i \tag{13}$$

5. Calculate the moments at the panel points along the pile (see Fig. 15c) using the equation

$$M_i = M_{i-1} + V_{i-1}\,(\beta L/n) \tag{14}$$

6. Apply the corrections (a uniform deflection and a uniform slope) that are necessary to give a deflected shape that satisfies all the boundary conditions. The final deflection at a panel point a distance βx from the ground surface will be equal to the sum of the

initial assumed deflection at that point, plus the necessary uniform deflection, and the distance βx times the necessary uniform slope.

7. Repeat steps 2, 3, 4, and 5 using the corrected deflected shape.

8. Calculate the distributed angle change at the panel points along the pile using the equation

$$C_i = -\frac{M_i}{EI} \tag{15}$$

9. Calculate the concentrated angle change at the panel points along the pile, using equations similar to (10), (11), and (12), except the distributed angle change replaces the distributed reaction and the concentrated angle change replaces the concentrated reaction.

10. Assume a slope at the origin (ground surface) and calculate the slope between the remaining panel points, using the equation

$$S_i = S_{i-1} + C_i \tag{16}$$

11. Assume a deflection at the origin and calculate the deflection at the remaining panel points, using the equation

$$y_i = y_{i-1} + S_{i-1}\,(\beta L/n) \tag{17}$$

12. Go to Step (2) and repeat the remaining steps until the desired accuracy is achieved.

The differential equations for the soil modulus variation $k_x = k$ were solved by means of Newmark's method and the coefficients compared with the exact ones as given by Timoshenko (20). Solutions were compared for the special case of a unit shear and zero moment acting at the pile top. The results showed an accuracy of at least four decimal places and this same accuracy is expected for the included tables.

Tabulation of Results

Once the boundary conditions at the ground surface and the variation of the coefficient of subgrade reaction along the pile have been estimated, the deflection, slope, moment, shear, and soil reaction can be determined from the non-dimensional coefficients in Tables 2 through 74. Each table is for a particular boundary condition and a particular variation of k.

Tables are included for Type I and Type III boundary conditions. Type I boundary conditions are differentiated by the particular value of the coefficient "A" and Type II boundary conditions by the particular value of the coefficient "J." The only exceptions are in Tables 39 through 44, where the boundary conditions are a unit moment and zero shear at the ground surface. Tables 2 through 38 are for Type I boundary conditions and give the coefficients for values of A of 0.0, 0.5, 1.0, 2.0, 4.0, and 8.0. For values of A other than those given in the tables, interpolation would be necessary. The difference between the given values of "A" is small enough so that linear interpolation is sufficiently accurate.

It should also be pointed out that Table 2 through 44 can also be used for Type II boundary conditions, where the moment at the ground surface is both positive and indeterminate. However, for the solution of problems having these boundary conditions, more interpolation will be required than for problems having Type I boundary conditions. For Type I boundary conditions the value of the ratio "A" will remain constant as the lateral load is increased, regardless of the non-linear behavior of the soil. For Type II boundary conditions the value of the ratio "A" will change, depending on the non-linear behavior of the soil. The increase in the non-linear behavior of the soil decreases the restraint of the soil on the pile and therefore causes a decrease in the value of "A." Hence, as the load on the pile is increased, the value of "A" should decrease.

The tables show that for values of "A" larger than approximately 12.0 to 16.0 the effect of the shearing force at the ground surface, V_o, on the deflection of the pile below the ground surface becomes quite small compared with the effect of the moment at the ground surface, M_o. Therefore, for values of "A" between 8.0 and 16.0 one can interpolate between the values for A = 8.0 (Tables 33 through 38) and the values for $M_o = M$ and $V_o = 0$ (Tables 39 through 44). For values of A greater than 16.0, it is sufficiently accurate to neglect the effect of the shear at the ground surface and use Tables 39 through 44 directly.

Type III boundary conditions are represented by the ratio "J," and coefficients are given for values of "J" of 0.0, -0.4, -1.0, -2.0, and -4.0. For other values of "J" interpolation would be necessary. A pile that is completely fixed against rotation at the ground surface would have a value for "J" of 0.0. As the restraint is decreased, the resulting moment at the ground surface decreases and the ratio, J, becomes more negative. The moment at the ground surface for a J of -4.0 is approximately a third of what it would be for a J of 0.0. Very few structures with Type III boundary conditions would be flexible enough to cause a moment this low, so the range of values given should cover almost all structures of this type.

Also some structures with Type II boundary conditions may have negative moments at the ground surface. For these cases, Tables 45 through 74 could be used by interpolating.

As stated earlier, for an ideal linear soil the variation in k along the length of the pile is assumed to be

$$k = n_h \ x = (\beta x/8.0) \ k_{8.0} \tag{18}$$

throughout the length of the pile. The first table for each given boundary condition (Tables 2, 8, 14, 20, 26, 33, 39, 45, 51, 57, 63 and 69) is for this linear variation of k. The remaining tables for each boundary condition are for one of the following variations of k above the first point of zero deflection:

$$k = [1.0 - (1.0 - \beta x/T)^R] \ (\beta x/8.0) \ k_{8.0} \tag{5}$$

$$k = [1.0 - (1.0 - \beta x/T)^R] \ [1.0 - (1.0 - \beta x/T)^U] \ (\beta x/8.0) \ k_{8.0} \tag{6}$$

The variation of k below the first point of zero deflection is taken as that given by Equation (18). The increasing non-linear behavior of the soil gives a greater deviation from the initial linear variation of k and this is achieved in Equations (5) and (6) by decreasing the values of either R or U. Equation (6) was used only in Tables 36 through 38 and Tables 42 through 44, in which cases the moment at the ground surface is positive and the shear at the ground surface is either zero or quite small when compared with the moment. For these cases the distance from the ground surface to the first point of zero deflection, "T," is smaller than for other cases and Equation (6) is used rather than Equation (5), since it gives a greater deviation from Equation (18) and increases the non-linear behavior of the soil.

All non-dimensional coefficients, except those in Tables 39 through 44, are for a unit positive shearing force applied at the ground surface. To obtain the numerical value for an actual pile, the following equations are to be used for all tables except for 39 through 44:

$$\text{Deflection} \quad y = \left(\frac{V_o}{EI\beta^3}\right) C_y \quad \text{(Length)} \tag{19}$$

$$\text{Slope} \quad S = \left(\frac{V_o}{EI\beta^2}\right) C_S \quad \text{(Dimensionless)} \tag{20}$$

$$\text{Moment} \quad M = \left(\frac{V_o}{\beta}\right) C_M \quad \text{(Force-Length)} \tag{21}$$

$$\text{Shear} \quad V = V_o\, C_v \quad \text{(Force)} \tag{22}$$

$$\text{Soil Reaction} \quad q = V_o \, \beta \, C_q \left(\frac{\text{Force}}{\text{Length}}\right) \tag{23}$$

C_y, C_S, C_M, C_V, and C_q are the non-dimensional coefficients for the deflection, slope, moment, shear, and soil reaction, respectively, at a distance βx below the ground surface.

The non-dimensional coefficients in Tables 39 through 44 are for a unit positive moment applied at the ground surface. To obtain the actual numerical values for a given moment and pile, the following equations should be used

$$\text{Deflection} \quad y = \left(\frac{M_0}{EI\beta^2}\right) C_y \tag{24}$$

$$\text{Slope} \quad S = \left(\frac{M_0}{EI\beta}\right) C_S \tag{25}$$

$$\text{Moment} \quad M = M_0 \, C_M \tag{26}$$

$$\text{Shear} \quad V = M_0 \, \beta \, C_V \tag{27}$$

$$\text{Soil Reaction} \quad q = M_0 \, \beta^2 \, C_q \tag{28}$$

C_y, C_S, C_M, C_V, and C_q are the non-dimensional coefficients for the deflection, slope, moment, shear, and soil reaction, respectively, at a distance βx below the ground surface.

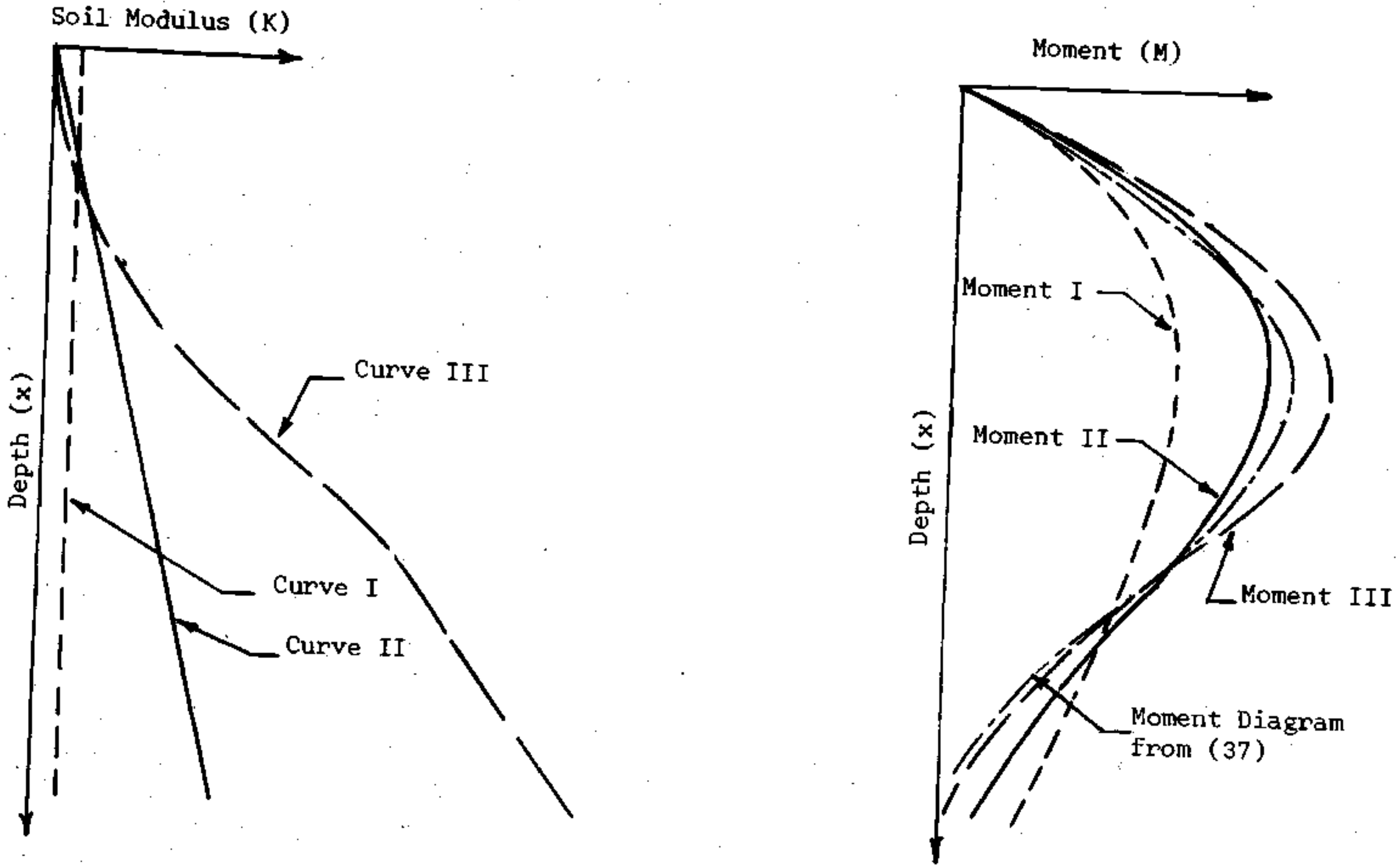
With the exception of Tables 45 through 50, coefficients are given for the top half of the pile, or down to $\beta x = 4.0$. The reason for this is that the coefficient values below that point are so small as to be insignificant. For a pile that is fixed against rotation at the ground surface, the distance, "T," down to the first point of zero deflection approaches 4.00, and therefore coefficients are included for the lower half to give some indication of the variation in that range.

Once the load-deformation characteristics of the surrounding soil have been determined for a given pile, the deflections, slopes, moments, shears, and soil reactions at points along the pile can easily be determined from the tables given in the Appendix. Examples I and II in the Appendix show how these coefficients can be used to solve actual problems.

Discussion of Results

The pile deflection at the ground surface is often used in place of load-deformation curves as the basis for analysing a laterally loaded pile. Example I in the Appendix demonstrates how the proposed method can be used to analyze a pile in a soil whose subgrade modulus increases linearly with the depth below the surface, using the deflection at the ground surface as the basis for computing the soil constants.

In order to obtain accurate results for the deflection, slope, moment, and shear based on the deflection at the ground surface, the estimated variation along the pile of the elastic k must be reasonably correct. The variation of k with depth has a significant influence on the maximum bending moment in the pile. Figure 16a shows three varia-



(a) Variations of k

(b) Moment Diagrams

Figure 16. Effect of Assumed Variation of k on the Moment Diagram for Equal Lateral Surface Deflection

tions of k with depth that will give the same deflection at the ground surface for a pile with a pure shearing force applied at that point ($A = 0$). Figure 16b shows the variation of the bending moments along the pile for the three variations of k. For the boundary condition $A = 0$, the magnitude of the maximum moments differ by more than 50 per cent, depending on which variation of k is used in the analysis.

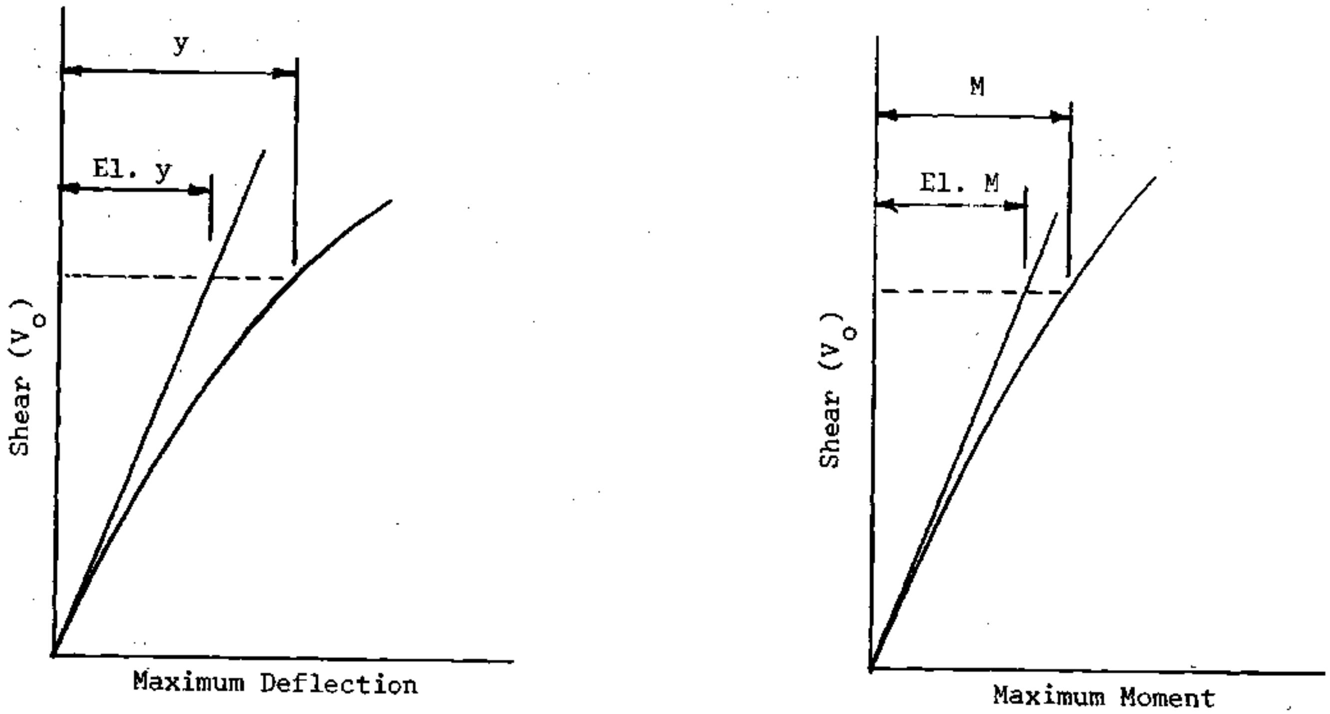
Figure 16 shows that for a given deflection at the ground surface, the variation of the soil modulus that has the smallest values of k in the region near the ground surface will give the largest bending moment in the pile. Therefore, if there is some doubt as to how k varies, a safe assumed variation of k would be similar to curve III in Fig. 16a, for which $R = 1.05$.

The influence of the soil properties in the region near the ground surface on the behavior of the pile is shown in Fig. 16. All three variations of k give the same deflection at the ground surface for a given pile with pure shear acting at the ground surface, in spite of the fact that the variations in k at depths below the ground surface are considerable.

The coefficients in the tables clearly show the effect of restraining the pile head on the maximum deflection and maximum moment in the pile. For an elastic soil with $k = (\beta x/8.0)(k_{8.0})$, a pile that is completely restrained against rotation at the ground surface ($J = 0$) will have a maximum deflection that is only 38 per cent of the maximum deflection that would occur if the pile head were free from restraint ($A = 0$). This effect has been observed in other theoretical and experimental studies. Davisson (41) states that tests have shown that a pile with a fixed head will have a maximum deflection of from 33 to 50 per cent of the maximum deflection of a free head pile, for the same lateral load. For the same two conditions, the absolute maximum moment for the fixed head pile will be 120 per cent of the absolute maximum moment for the pile that is free from restraint. The maximum moment in the fixed head pile is negative whereas the maximum moment in the free head pile is positive.

The effects of reducing the restraint of the pile head (making J become more negative) can also be seen from the tables. As J becomes more negative the magnitude of the maximum negative moment is reduced, while the magnitude of the maximum positive moment is increased and the maximum deflection is also increased. For the elastic soil, the magnitude of the absolute maximum moment reaches a minimum around J = -2.0, at which value the magnitude of the maximum negative moment is approximately equal to the magnitude of the maximum positive moment in the pile. Consequently, if the restraint at the pile head can be chosen during the design of the pile and the structure designed such that J is approximately -2.0, the required cross-section would be a minimum. If the maximum deflection controls the design either the restraint should be increased or the moment of inertia increased.

The tables also show effect of the inelastic behavior of the soil on the behavior of the pile. Larger deflections and bending moments would obviously occur in a pile in a non-linear soil, than for the same pile if the soil had continued to behave linearly. This has been verified experimentally as well as theoretically. If the soil behaved linearly with the lateral load, as shown in Fig. 17a and 17b. The true



(a) Effect on Deflection

(b) Effect on Maximum Moment

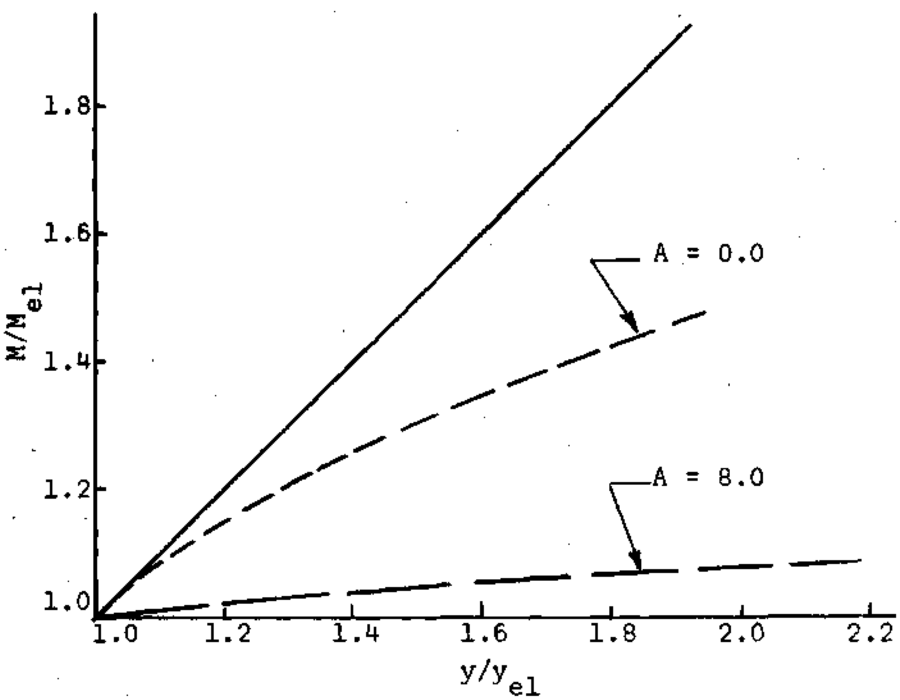
Figure 17. Effect of Inelastic Behavior of the Soil on the Maximum Deflection and Moment

relationship is the curve shown in the same figures.

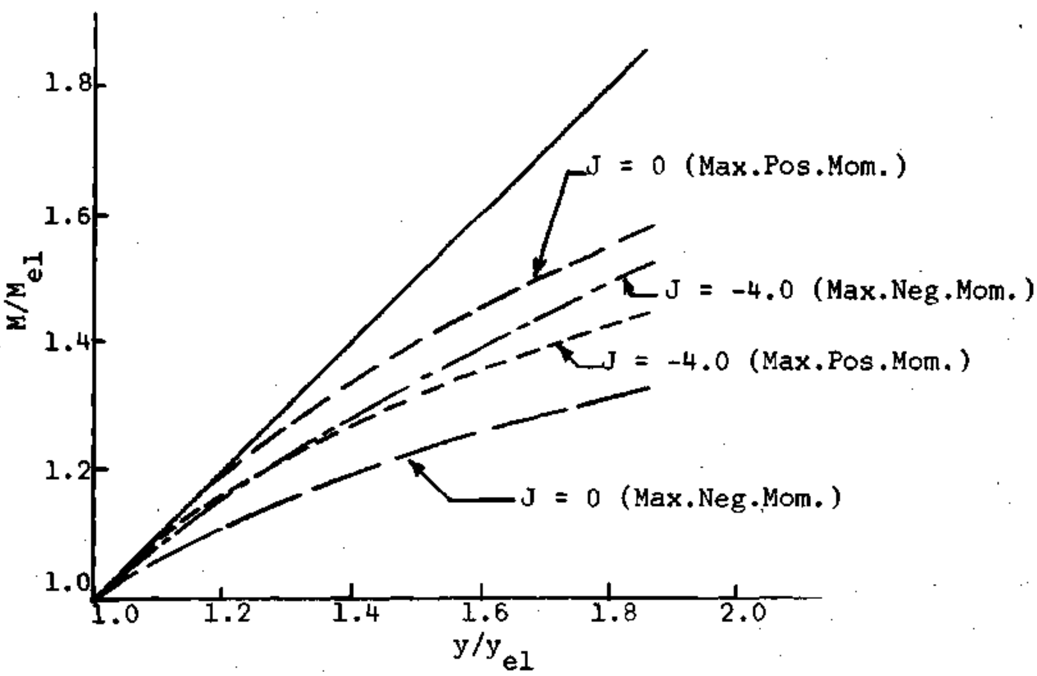
The coefficients in the tables show that the inelastic behavior of the soil has a greater effect on the maximum deflection of the pile than it does on the maximum bending moment in the pile. The coefficients from the tables were used to plot the curves in Fig. 18, where y and M are the maximum deflection and moment in the pile, respectively, for an inelastic soil. y_{el} and M_{el} are the maximum deflection and moment which would occur if k continued to increase linearly with depth. The curves in Fig. 18a are for piles with free heads (Type I boundary conditions) and those in Fig. 18b are for piles with restrained heads (Type III boundary conditions).

The curves show that as the inelastic behavior of the soil becomes greater and the ratio y/y_{el} increases, the difference between the effect on the maximum moment and the effect on the maximum deflection becomes greater. If the effects were the same for both, the relationship between M/M_{el} and y/y_{el} would be a straight line instead of the curves shown. Fig. 18a shows that for an A greater than 1.0, the inelastic behavior of the soil has a negligible effect on the maximum bending moment. For values of A larger than this the maximum moment is approximately equal to the moment at the ground surface, regardless of the extent of the inelastic behavior of the soil.

The inelastic behavior of the soil also causes the distances from the ground surface to the first point of zero deflection and the first point of inflection to increase as the soil is stressed further into the inelastic range. The distance to the first point of zero deflection increases approximately from $0.10/\beta$ to $0.125/\beta$ for an increase in the



(a) Piles with Free Heads



(b) Piles with Restrained Heads

Figure 18. Comparison of the Effect of the Inelastic Behavior on the Maximum Moment and Deflection

maximum deflection of from 15 to 20 per cent. This seems to be true regardless of the boundary conditions at the ground surface. The increase in the distance to the first point of inflection depends considerably on the boundary conditions.

A comparison of the results of a test conducted by Loos and Breth (37) with the results given by the coefficients in the appendix is shown in Figure 16b. The moment diagram was obtained by Loos and Breth by placing strain gages at points along a model pile, in a uniform sand, that was loaded by a pure shear at the ground surface.

The comparison shows that for the segment of the pile where the maximum positive moments occur the test moment diagram falls between Diagram II and Diagram III, or approximately where the diagrams for R = 5.00 and R = 2.75 would be. The test diagram shows moments less than those for Diagram II in the region near the ground surface. This indicates that the lateral resistance of the sand used by Loos and Breth was greater than that given by Curve II in Figure 16a in the region very near the ground surface, but the resistance of the sand rapidly decreased to less than that of Curve II, such that the absolute maximum moment was less than that given by Curve II.

CHAPTER IV

CONCLUSIONS

A method has been proposed for the analysis of elastic laterally loaded long piles in a non-linear inelastic soil whose coefficient of horizontal subgrade reaction in the elastic range is zero at the ground surface and increases linearly with depth. The method can be used for other soils, but should give less accurate and safer results since most other soils would be stronger in the region near the ground surface.

The non-linear inelastic behavior of the soil was taken into account by reducing the coefficient of horizontal subgrade reaction at points between the ground surface and the first point of zero deflection, the degree of reduction depending on the extent of the non-linear action. This procedure yielded results that satisfy load-deflection curves typical of soils, including the portion of the curve with a negative slope beyond the ultimate strength of the soil.

The solutions are presented in the form of tables for common types of boundary conditions at the ground surface. These coefficients can be used to determine the deflection, slope, moment, shear, and soil reaction at points along the pile length.

The solutions also give the following qualitative information on the comparative effects of elastic soils and non-linear inelastic soild on the behavior of laterally loaded piles.

1. The non-linear inelastic behavior of the soil increases the

magnitudes of both the maximum deflection and bending moment in the pile.

2. The effect of this behavior of the soil on the maximum bending moment was not as great as the effect on the maximum deflection, with the difference between the two increasing as the non-linear behavior became greater. The explanation for this is that the deflection is proportional to a higher power of the span than the moment is, and the effect of the non-linear behavior is to increase the span.

3. For values of $A = M_o\beta/V_o$ greater than approximately 8.0, the non-linear inelastic behavior does not increase the maximum moment by an appreciable amount, but it does affect the maximum deflection.

4. The non-linear inelastic behavior of the soil causes the distances from the ground surface to the point of maximum moment, to the first point of zero deflection, and to the first point of inflection to increase as the non-linear behavior of the soil increases.

Also, an analysis of a pile, using values for the coefficient of horizontal subgrade reaction that are based solely on the deflection at the ground surface, can give inaccurate results unless a good approximation of the true variation with depth is used. As an example, for different assumed variations with depth the values of the maximum bending moments can differ by as much as 50 per cent from the true maximum. The variation of the coefficient with depth that will give the largest bending moment is the variation that gives the lowest coefficients in the region near the ground surface. Therefore, if there is some question as to the true variation, a safe assumption would be a weak soil near the ground surface.

The results also showed that for values of A greater than approximately 16.0, the effect of the shear at the ground surface on the deflection and bending moment below the surface can be neglected.

Since solutions for a linear variation of the coefficient of horizontal subgrade reaction have been giving acceptable results, even though the true variation is non-linear in the region near the ground surface, the new coefficients should give results that closely approximate the true behavior. Close comparison was shown with the results from tests on a model pile in sand. However, field tests on piles with a variety of boundary conditions at the ground surface, where the deflection and slope at the ground surface and the strains at points along the pile length are measured, should be made for further verification.

There is a critical need for a reliable technique for obtaining the soil reaction-deflection curves for points a given distance below the ground surface. Such a technique would be of considerable value in using this and other methods of analysing piles.

A possible extension of the proposed method would be its application to the calculation of buckling loads of piles with different boundary conditions at the ground surface.

APPENDIX A

EXAMPLE ONE

ANALYSIS OF A LATERALLY LOADED PILE

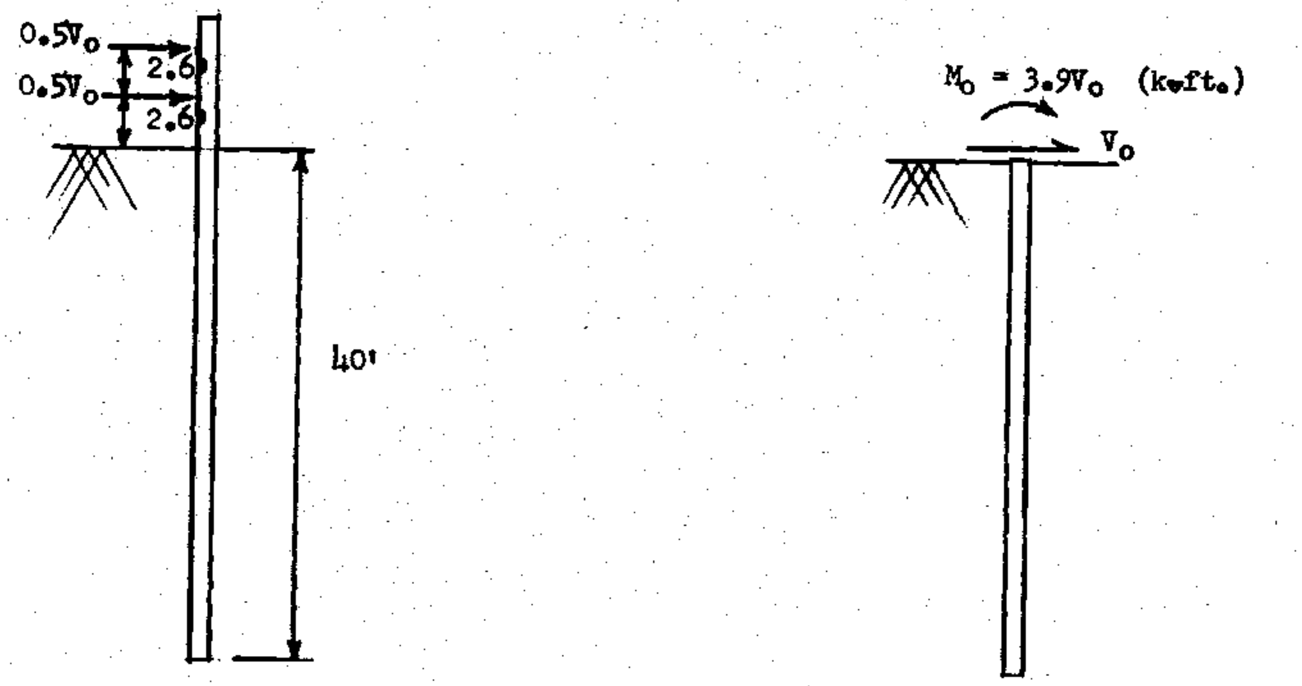
APPENDIX A

EXAMPLE ONE

Fig. 19a shows a steel pile with an outside diameter of 16 inches and a wall thickness of 0.656 inches, that has a length of 40 feet below the ground surface. It must resist the forces shown. Only the part of the pile below the ground surface is to be analyzed. Therefore, a section is cut at the ground surface and the shear and moment acting at that point are determined and shown in Fig. 19b. As the pile is loaded and unloaded the magnitudes of the lateral load and the deflection at the ground surface are recorded and the curve shown in Fig. 20 is plotted. The soil is assumed to be such that $k = (\beta x/8.0)(k_{8.0})$ can be assumed to be a good approximation of k in the elastic range. The coefficients in the tables will be used to obtain the deflection and the moment diagrams along the pile during loading and unloading. Also load-deformation curves will be obtained for the soil at various depths below the ground surface.

Solution

If the soil remained linear and elastic throughout the entire range of the applied load, the load-deflector curve would be a straight line tangent at the origin to the actual load-deflection curve. To determine β, values for the load and deflection at some point on this straight line are determined and substituted in the following equation.



(a) Loaded Pile

(b) Forces at Ground Surface

Figure 19. Laterally Loaded Pile with Type I Boundary Conditions

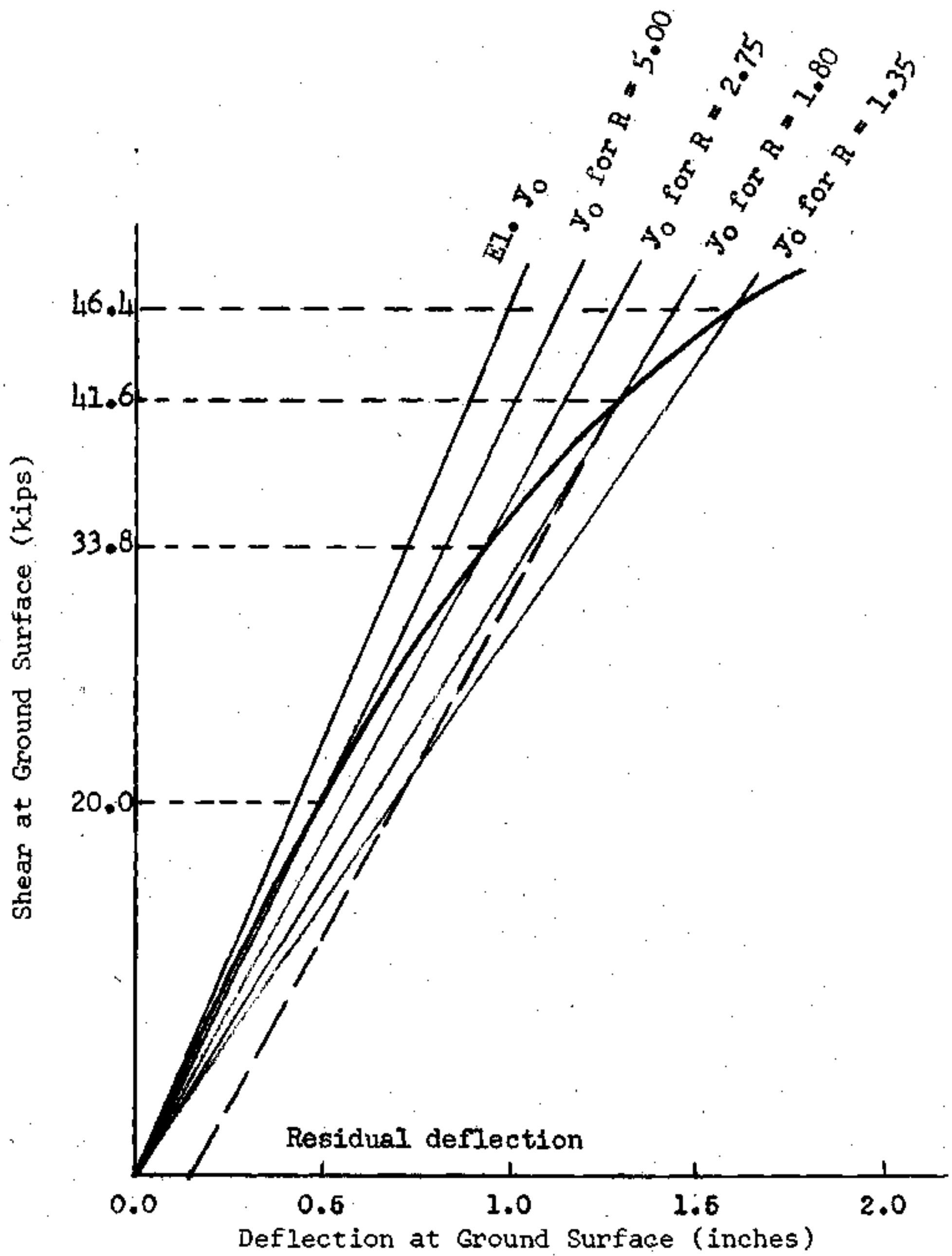


Figure 20. Load-Deflection Curve for a Laterally Loaded Pile at the Ground Surface

$$y_o = \frac{V_o}{EI\beta^3} C_y' + \frac{M_o}{EI\beta^2} C_y''$$

V_o = 40.0 kips

M_o = 3.9 V_o = 156 kip-ft.

E = 30,000 kips per sq. in.

I = 932 $in.^4$

C_y' = coefficient for the deflection at the ground surface due to V_o = 3.682 (from Table 2)

C_y'' = coefficient for the deflection at the ground surface due to M_o = 2.137 (from Table 39)

y_o = 0.855 inches

Substituting these values in the above equation gives the following cubic equation for β.

$$6{,}000\beta^3 = 0.03682 + 1.00\beta$$

There are three roots to this equation, one real and two imaginary. The real root has a value of 0.0213 $inches^{-1}$ or 0.256 $feet^{-1}$ and this is the value of β that is desired. The length, L, below the ground surface to the point where βL = 8.0 is then 31.2 feet. This will be assumed length of the pile, since the difference between the behavior of a pile of this length and the behavior of one 40.0 feet long is negligible. The value for A then becomes

$$A = M_o\beta/V_o = (3.9)(0.256) = 1.00$$

Therefore, Tables 14 through 19 will be used for the analysis.

The expressions for the deflection, moment, and soil reaction at various points along the pile then become

$$y = \frac{V_o}{EI\beta^3} C_y = \frac{V_o}{272} C_y \qquad \text{(inches) for } V_o \text{ in kips}$$

$$M = \frac{V_o}{\beta} C_M = 3.9\ V_o\ C_M \qquad \text{(k-ft.) for } V_o \text{ in kips}$$

$$q = V_o\ \beta\ C_q = 21.4\ V_o\ C_q \qquad \text{(lb./in.) for } V_o \text{ in kips}$$

The coefficients for the deflection at the ground surface are then as follows:

For R = 5.00	$C_y = -6.65$	$y_o = 0.0244\ V_o$
For R = 2.75	$C_y = -7.49$	$y_o = 0.0275\ V_o$
For R = 1.80	$C_y = -8.44$	$y_o = 0.0310\ V_o$
For R = 1.35	$C_y = -9.31$	$y_o = 0.0342\ V_o$
For R = 1.05	$C_y = -10.23$	$y_o = 0.0375\ V_o$

These equations give the load-deflection lines shown in Fig. 20. The load-deflection line for R = 5.00 intersects the true load-deflection curve at V_o = 20.0 kips, the line for R = 2.75 at 33.8 kips, the line for R = 1.80 at 41.8 kips, and the line for R = 1.35 at 46.4 kips. At these particular values for V_o the variation of k above the first point of zero deflection is assumed to be that given by Equation (4) for the corresponding value of R. The variation of the deflection, slope, moment, shear, and soil reaction along the pile can then be found from the tables for these values of V_o.

The computations for R = 1.80 and V_o = 41.6 kips are shown below. The coefficients can be obtained from Table 17. The computations for other values of R would be made in the same manner.

R = 1.80 $\qquad$ V_o = 41.6 kips

__Deflection__ $\qquad$ (41.6)/(272 = 0.153

βx = 0.0	x = 0.00 ft.	y =-(8.44)(0.153) = -1.29 in.
βx = 0.4	x = 1.56 ft.	y =-(6.41)(0.153) = -0.982 in.
βx = 0.8	x = 3.12 ft.	y =-(4.61)(0.153) = -0.706 in.
βx = 1.2	x = 4.68 ft.	y =-(3.09)(0.153) = -0.473 in.
βx = 1.6	x = 6.25 ft.	y =-(1.88)(0.153) = -0.288 in.
βx = 2.0	x = 7.81 ft.	y =-(0.975)(0.153) = -0.149 in.
βx = 2.4	x = 9.37 ft.	y =-(0.362)(0.153) = -0.0554 in.

__Moment__ $\qquad$ (3.9)(41.6) = 162

βx = 0.0	M = (1.00)(162) = 162 k-ft.
βx = 0.4	M = (1.40)(162) = 227 k-ft.
βx = 0.8	M = (1.74)(162) = 282 k-ft.
βx = 1.2	M = (1.95)(162) = 316 k-ft.

$\beta x = 1.6$ $M = (1.97)(162) = 319$ k-ft.

$\beta x = 2.0$ $M = (1.81)(162) = 293$ k-ft.

$\beta x = 2.4$ $M = (1.51)(162) = 245$ k-ft.

Soil Reaction $(21.4)(41.6) = 890$

$\beta x = 0.0$ $q = (0.000)(890) = 0$

$\beta x = 0.4$ $q = (0.313)(890) = 278$ lb./in.

$\beta x = 0.8$ $q = (0.845)(890) = 752$ lb./in.

$\beta x = 1.2$ $q = (1.19)(890) = 1060$ lb./in.

$\beta x = 1.6$ $q = (1.18)(890) = 1050$ lb./in.

$\beta x = 2.0$ $q = (0.877)(890) = 782$ lb./in.

$\beta x = 2.4$ $q = (0.422)(890) = 376$ lb./in.

The curves for the deflection, moment, and soil reaction for $V_o = 41.6$ kips are shown in Fig. 21.

When a pile is unloaded, it does not always return to its original undeflected position, due to the inelastic behavior of the soil. Consequently, there are locked in moments at points along the pile due to the inability of the pile to rebound to its original position. The method proposed can also be used to predict the moment along the pile after the lateral load has been completely removed. As an example, assume that the pile is initially loaded up to 41.6 kips and then the load is removed. If the deflection left in the pile at the ground surface is 0.144 inches, as shown in Fig. 20, the variation for k along the pile during unloading can be found as follows.

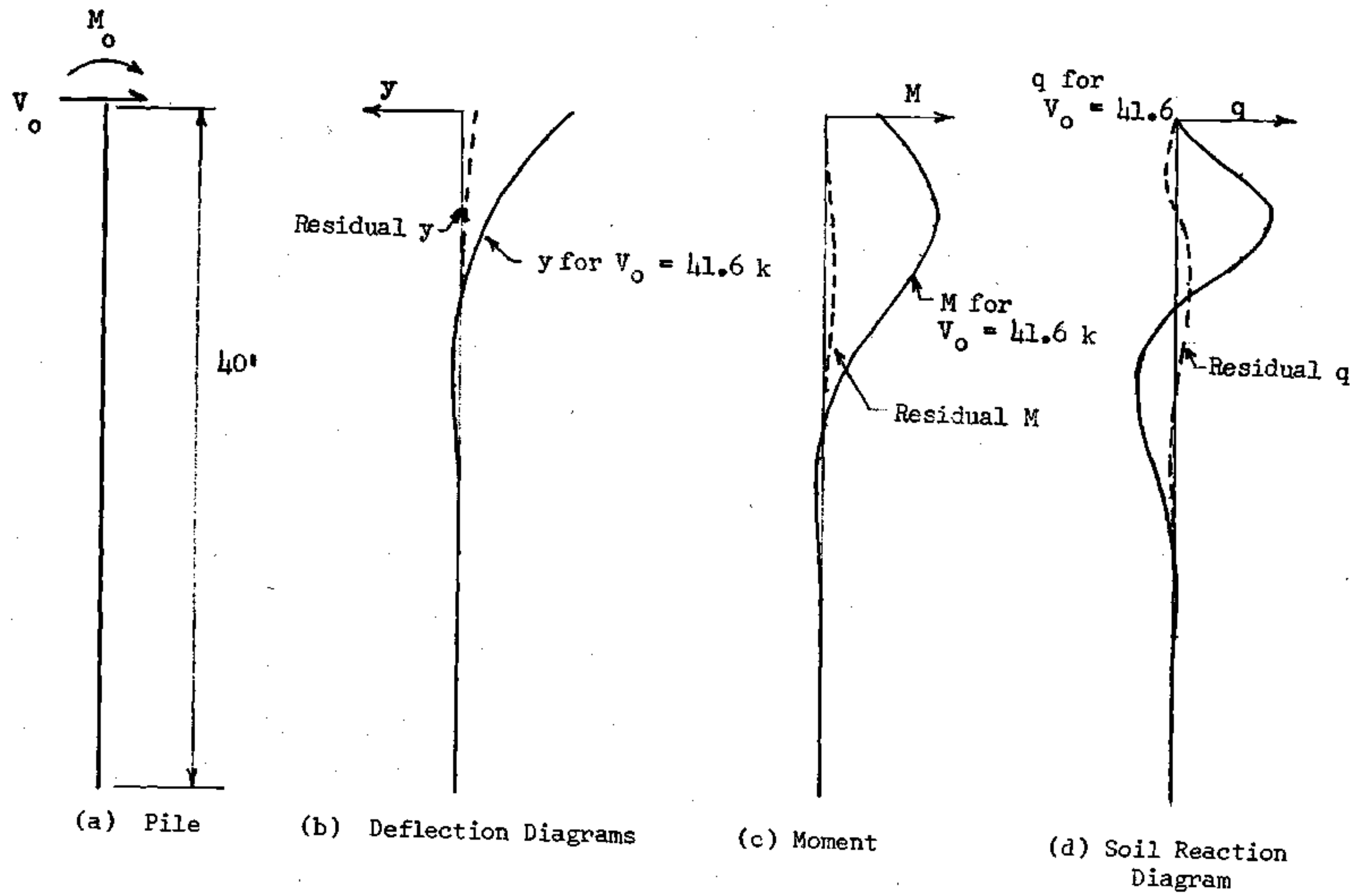


Figure 21. Deflection, Moment, and Soil Reaction Curves for Example One

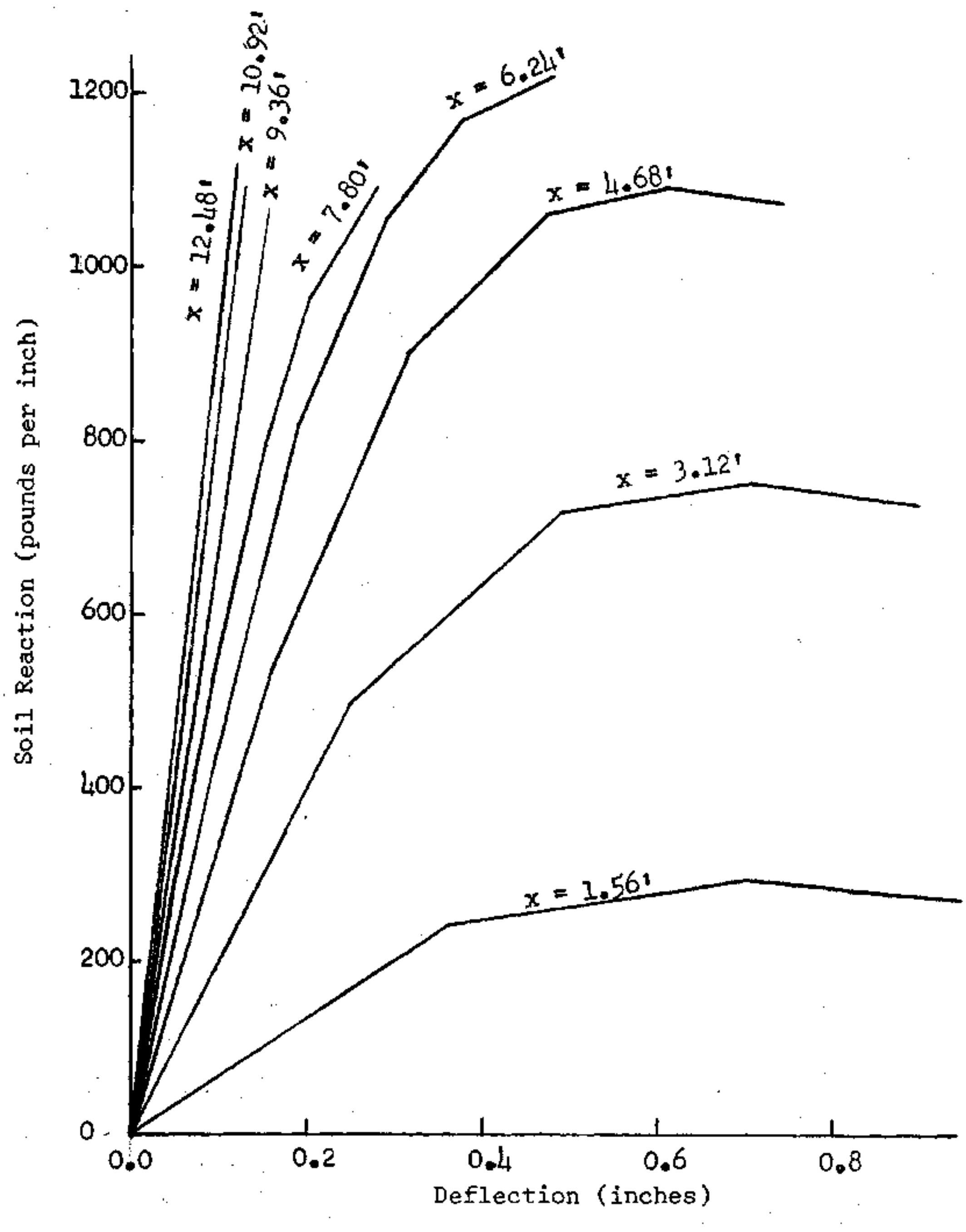


Figure 22. Soil Reaction--Deflection Curves for Given Depths

Due to a lateral load of 41.6 kips, the initial deflection, y_o', is 1.29 inches. Due to removal of the 41.6 kip load, the change in deflection is equal to

$$y_o'' = -\frac{41.6}{272}(C_y'') = -0.153\ C_y''$$

The final deflection at the ground surface, 0.144 inches, is equal to the difference between y_o' and y_o''. This equation will give the value for C_y'', and the value of R during unloading can be determined from C_y''.

$$-1.29 + 0.153\ C_y'' = -0.144 \text{ in.}$$

$$C_y'' = \frac{1.15}{0.153} = 7.52$$

The value of R that has C_y at the ground surface nearest to 7.52 will be the one that is assumed to define k along the pile during unloading. C_y at the ground surface is found to be 7.493 for R = 2.75 in Table 16. To get the resulting deflection, moment, and soil reaction along the pile after the load has been removed the coefficients from Table 16 and Table 17 are used as follows.

Deflection

$\beta x = 0.0$ $\quad y = (0.153)(-8.436 + 7.493) = -0.144$ in.

$\beta x = 0.4$ $\quad y = (0.153)(-6.414 + 5.620) = -0.121$ in.

$\beta x = 0.8$ $\quad y = (0.153)(-4.614 + 3.970) = -0.097$ in.

$\beta x = 1.2$ $\quad y = (0.153)(-3.091 + 2.592) = -0.076$ in.

$\beta x = 1.6$ $y = (0.153)(-1.876 + 1.514) = -0.066$ in.

$\beta x = 2.0$ $y = (0.153)(-0.975 + 0.733) = 0.037$ in.

$\beta x = 2.4$ $y = (0.153)(-0.362 + 0.217) = -0.022$ in.

Moment

$\beta x = 0.0$ $M = (162)(1.000 - 1.000) = 0.0$ k-ft.

$\beta x = 0.4$ $M = (162)(1.395 - 1.394) = 0.162$ k-ft.

$\beta x = 0.8$ $M = (162)(1.737 - 1.720) = 2.76$ k-ft.

$\beta x = 1.2$ $M = (162)(1.947 = 1.891) = 9.08$ k=ft.

$\beta x = 1.6$ $M = (162)(1.972 = 1.867) = 17.0$ k-ft.

$\beta x = 2.0$ $M = (162)(1.812 - 1.667) = 23.5$ k-ft.

$\beta x = 2.4$ $M = (162)(1.514 - 1.354) = 27.6$ k-ft.

Soil Reaction

$\beta x = 0.0$ $q = (890)(0.000 - 0.000) = -0.00$ lb./in.

$\beta x = 0.4$ $q = (890)(0.313 - 0.407) = -83.5$ lb./in.

$\beta x = 0.8$ $q = (890)(0.845 - 0.997) = -135$ lb./in.

$\beta x = 1.2$ $q = (890)(1.185 - 1.259) = -65.8$ lb./in.

$\beta x = 1.6$ $q = (890)(1.181 - 1.117) = 67.0$ lb./in.

$\beta x = 2.0$ $q = (890)(0.877 - 0.718) = 141.5$ lb./in.

$\beta x = 2.4$ $q = (890)(0.422 - 0.260) = 144.2$ lb./in.

If there is a significant difference between the actual A at the ground surface and the nearest value of A in the tables, then interpolation should be used, except when A is greater than approximately 16.0. Interpolation between the results for two different values of R is not justified since their results do not differ appreciably. Use of the lower of the two values of R or U would give results that are safe. This would apply in most cases except when unloading, where the difference between the R used in loading and the R used in unloading that is the greatest would give the largest residual moment and deflection.

APPENDIX B

EXAMPLE TWO

ANALYSIS OF A LATERALLY LOADED PILE

APPENDIX B

EXAMPLE TWO

Fig. 23 shows a structure supported on two piles that have the same cross-section and length as the pile in example one. However, in this structure the pile is restrained against rotation at the ground surface by the structure above. The soil reaction-deflection curves developed in the first example are assumed to describe the behavior of the soil for this example also, as shown in Fig. 20. The coefficients in the tables and these curves will be used to predict the deflections and moments at points along the pile due to a shearing force at the ground surface of 60 kips in each pile.

Initially, the value of β at a distance $\beta L = 8.0$ from the ground surface should be computed. The soil reaction-deflection curves show that at a depth of 12.48 ft. the soil is approximately elastic. Hence, the tangent to the curve for x = 12.48 ft. is taken as the elastic line. The slope of this line is the elastic k for that point.

At x = 12.48 ft. $\quad k = \frac{q}{y} = \frac{1000}{0.108} = 9{,}260 \text{ lb./in.}^2$

At x = 40.0 ft. $\quad k = \frac{40.0}{12.5}(9{,}260) = 29{,}700 \text{ lb./in.}^2$

$$\beta = \frac{29{,}700}{(4)(30)(10)^6(932)} = 1/44.1 \text{ in.}^{-1}$$

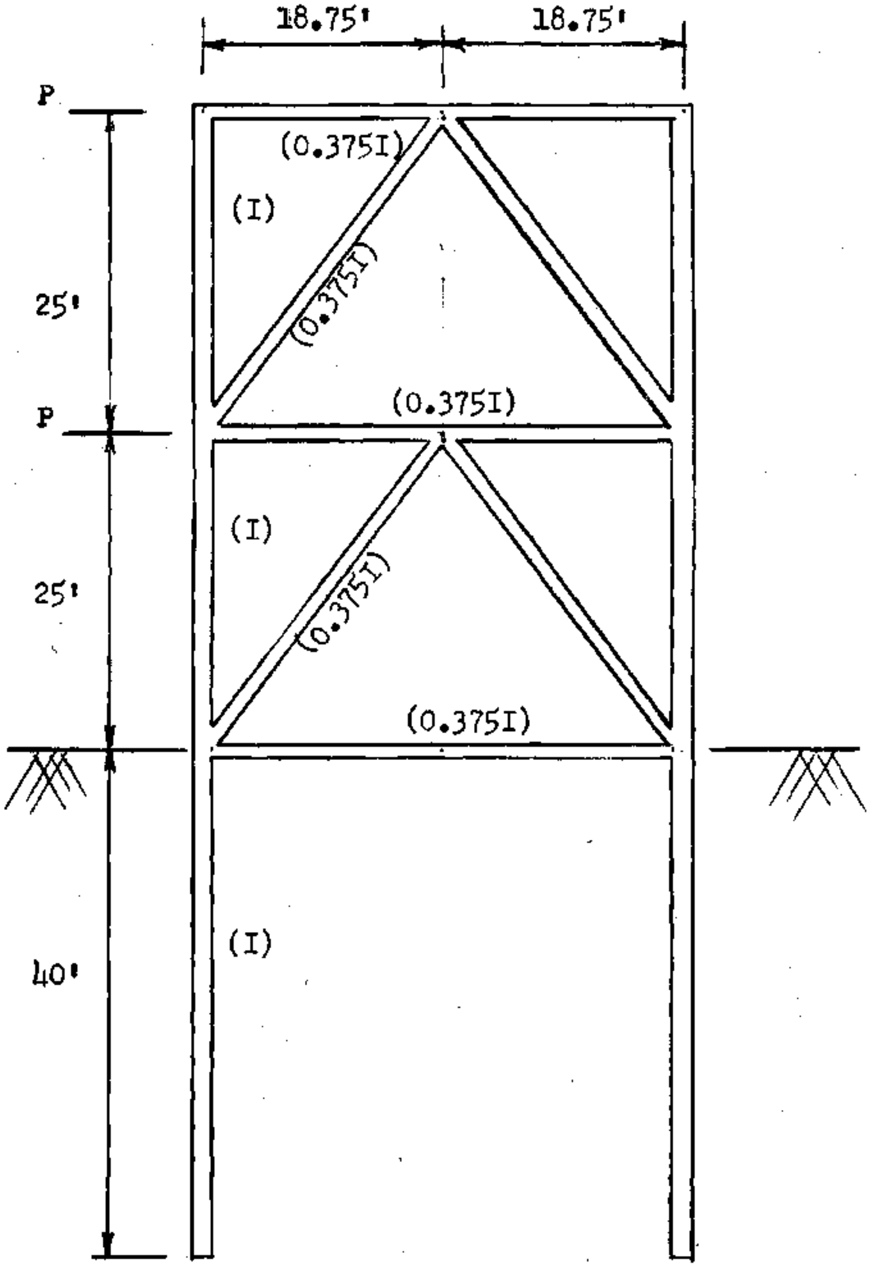


Figure 23. Pile Supported Structure for Example Two

The actual $$\beta L = \frac{(40)(12)}{(44.1)} = 10.9$$

To find the depth to

$$\beta L = 8.0 \qquad \alpha = \frac{(8.0)}{(10.9)} = 0.735$$

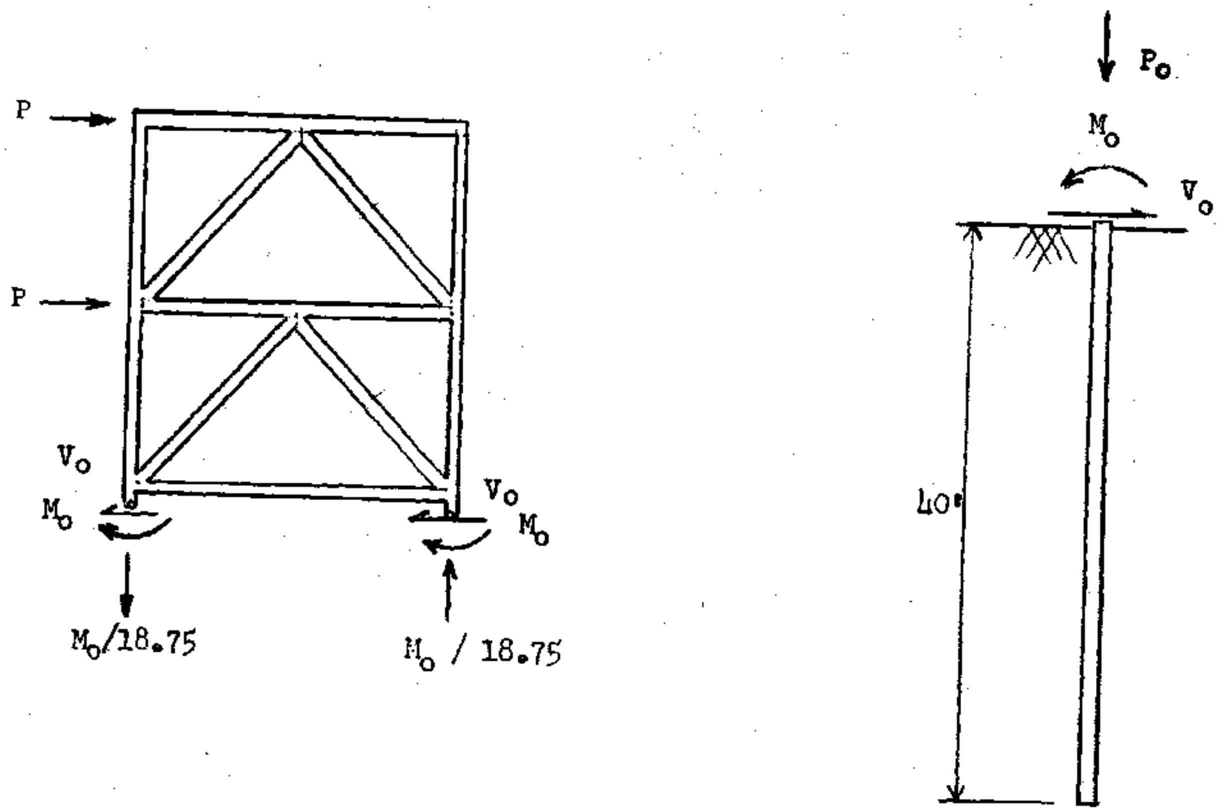
From Table 1 $$\frac{L_{8.0}}{40.0} = 0.781$$

$$L_{8.0} = (0.781)(40.0) = 31.2 \text{ ft.}$$

Therefore, the pile is assumed to be 31.2 ft. long. At $x = 31.2$ ft. the value for β is $(8.0)/(31.2) = 0.256$ ft.$^{-1}$.

The boundary conditions at the ground surface are Type III and the numerical value for J must be obtained to predict the behavior of the pile. To calculate the value for J, a moment M_o is applied to the structure at the two points where the piles join the structure (see Fig. 24a). These applied moments cause indeterminate moments to be set up in the members of the structure. Several methods are available for calculating these indeterminate moments, one of which is moment distribution. Once these moments have been obtained, the slopes in the structure at the joint where the pile joins the structure can be calculated in terms of M_o. This will give the ratio J.

Taking advantage of the symmetry of the structure, moment distribution was used to calculate the indeterminate moments. The moment at the end of the horizontal member at the ground surface is found to be



(a) Free-body of Structure

(b) Loads at Ground Surface

Figure 24. Free-bodies of the Structure and the Pile

$0.237\ M_o$. This gives the following value for the slope at the joint and the value for J:

$$s = -\frac{3.95\ M_o}{EI\beta}$$

$$J = s(EI\beta/M_o) = (-3.95)(0.256) = -1.01$$

If J is rounded to -1.00 the results will not be affected to any significant degree and the coefficients can be found in Tables 57 through 62.

The variation of k that best approximates the true variation represented by the soil reaction-deflection curves is not known. Therefore, several values of R will be tried to obtain the best approximation. For the first trial use R = 5.00 (Table 58).

For the deflection $$y = \frac{V_o}{EI\beta^3}$$

$$C_y = 0.221\ C_y \qquad \text{(in.)}$$

For the soil reaction $$q = (V_o\beta)$$

$$C_q = 1.280\ C_q \qquad \text{(lb./in.)}$$

R = 5.00

Deflection

βx = 0.0	x = 0.00 ft.	y = -(0.221)(2.50) = -0.552 in.
βx = 0.4	x = 1.56 ft.	y = -(0.221)(2.13) = -0.471 in.
βx = 0.8	x = 3.12 ft.	y = -(0.221)(1.70) = -0.376 in.
βx = 1.2	x = 4.68 ft.	y = -(0.221)(1.26) = -0.278 in.
βx = 1.6	x = 6.24 ft.	y = -(0.221)(0.867) = -0.192 in.
βx = 2.0	x = 7.30 ft.	y = -(0.221)(0.539) = -0.119 in.
βx = 2.4	x = 9.36 ft.	y = -(0.221)(0.289) = -0.064 in.
βx = 2.8	x = 10.92 ft.	y = -(0.221)(0.117) = -0.026 in.

Soil Reaction

βx = 0.0	q = (1,280)(0.000) = 0.000 lb./in.
βx = 0.4	q = (1,280)(0.205) = 262 lb./in.
βx = 0.8	q = (1,280)(0.514) = 657 lb./in.
βx = 1.2	q = (1,280)(0.682) = 874 lb./in.
βx = 1.6	q = (1,280)(0.670) = 857 lb./in.
βx = 2.0	q = (1,280)(0.534) = 683 lb./in.
βx = 2.4	q = (1,280)(0.347) = 445 lb./in.
βx = 2.8	q = (1,280)(0.164) = 210 lb./in.

These points are then plotted on the soil reaction-deflection curves in Fig. 25 as ⊕ . This shows that for depths below the ground surface of 3.12 ft., 4.68 ft., 6.24 ft., and 7.80 ft. these points are somewhat above the true curves, or a little on the unsafe side.

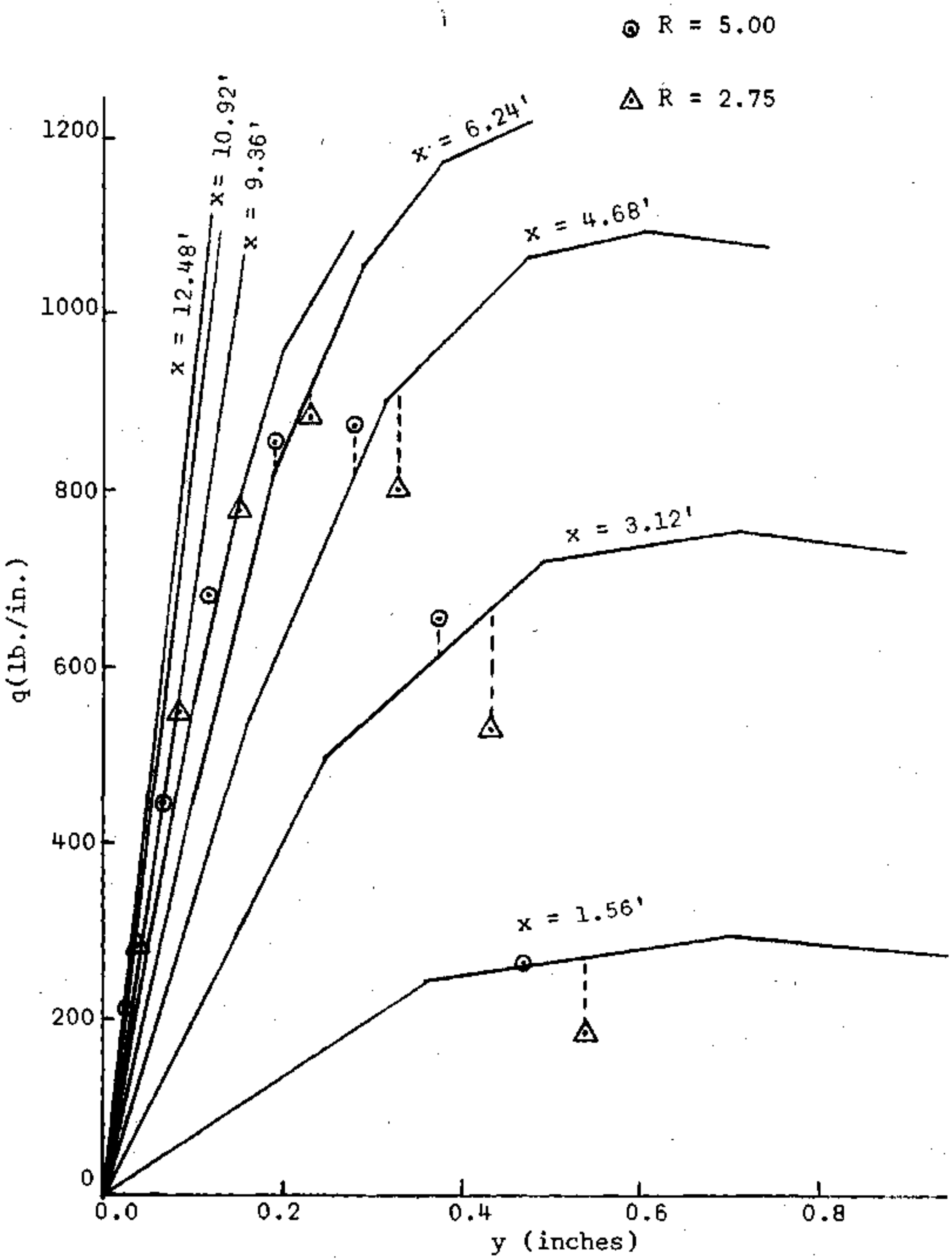


Figure 25. Soil Reaction--Deflection Curves

So a weaker variation of k will be true, the next being R = 2.75. The deflections and soil reactions will then be computed for this value of R, using Table 59, and the results compared with the true curves.

R = 2.75

Pile Deflection

$\beta x = 0.0$	$y = (0.221)(2.84) = 0.628$ in.
$\beta x = 0.4$	$y = (0.221)(2.44) = 0.540$ in.
$\beta x = 0.8$	$y = (0.221)(1.97) = 0.435$ in.
$\beta x = 1.2$	$y = (0.221)(1.49) = 0.329$ in.
$\beta x = 1.6$	$y = (0.221)(1.04) = 0.230$ in.
$\beta x = 2.0$	$y = (0.221)(0.664) = 0.147$ in.
$\beta x = 2.4$	$y = (0.221)(0.371) = 0.0820$ in.
$\beta x = 2.8$	$y = (0.221)(0.164) = 0.0362$ in.

Soil Reaction

$\beta x = 0.0$	$q = (1{,}280)(0.000) = 0$
$\beta x = 0.4$	$q = (1{,}280)(0.144) = 184$ lb./in.
$\beta x = 0.8$	$q = (1{,}280)(0.416) = 532$ lb./in.
$\beta x = 1.2$	$q = (1{,}280)(0.629) = 805$ lb./in.
$\beta x = 1.6$	$q = (1{,}280)(0.694) = 886$ lb./in.
$\beta x = 2.0$	$q = (1{,}280)(0.609) = 779$ lb./in.
$\beta x = 2.4$	$q = (1{,}280)(0.431) = 551$ lb./in.
$\beta x = 2.8$	$q = (1{,}280)(0.228) = 292$ lb./in.

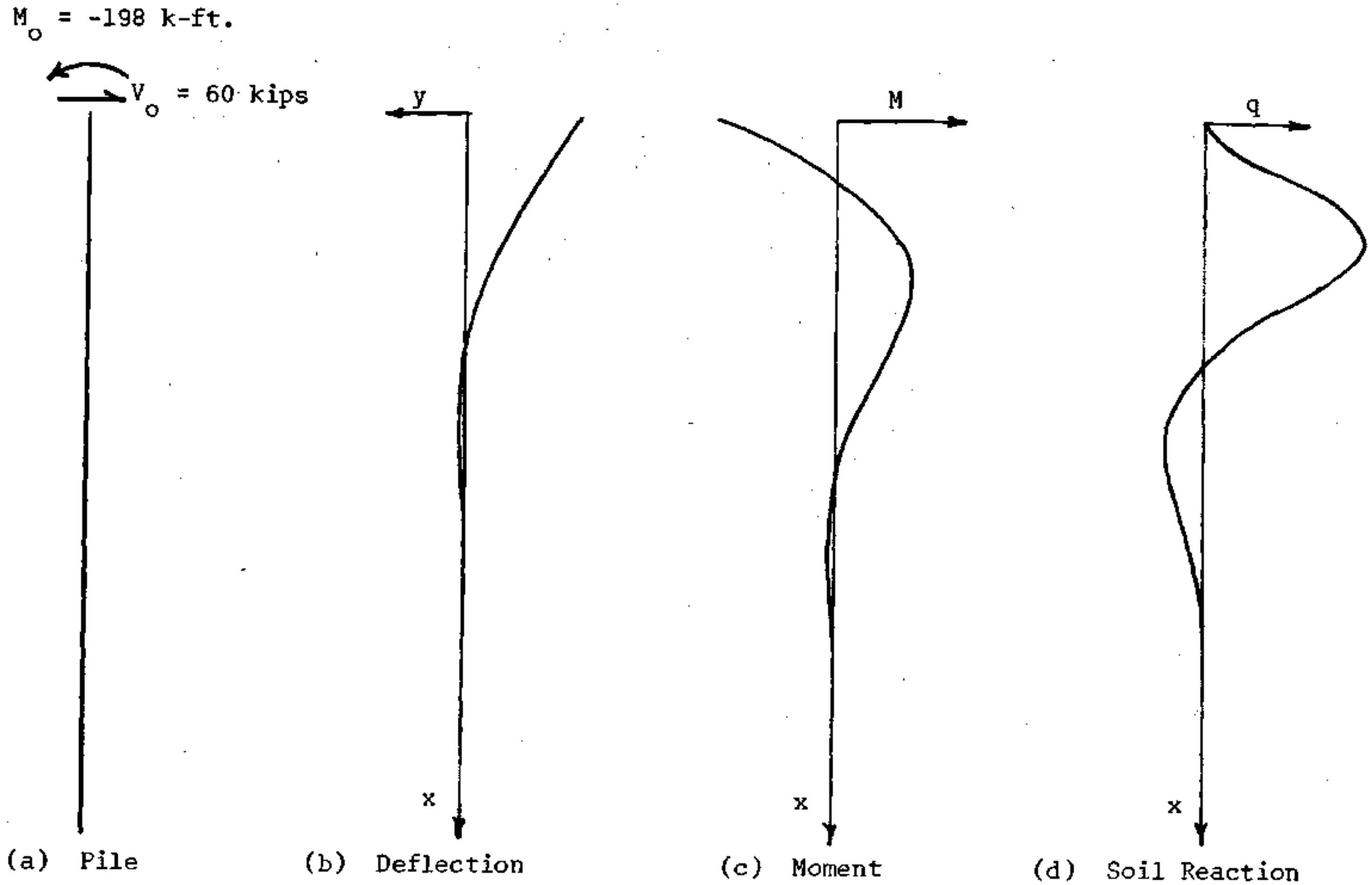


Figure 26. Behavior of Pile Due to 60 kip Lateral Load

These points are then plotted on the soil reaction-deflection curves in Fig. 25 as ▲. This shows that for depths of less than 6.24 ft. these points are below the soil reaction-deflection curves, or they are on the safe side. For depths greater than 6.24 ft. the points are on the stress-strain curves.

Since the results for R = 5.00 are slightly on the unsafe side and the results for R = 2.75 are on the safe side for points near the ground surface, the true variation of k will be somewhere between these two. However, R = 2.75 will be assumed as the correct variation, since it gives results that are on the safe side and should be accurate enough since the difference between the behavior for R = 5.00 and R = 2.75 is not too great.

The computations for the moment diagram are as follows:

$$(60)/(0.256) = .234$$

$\beta x = 0.0$ $\quad M = (234)(-0.848) = -198$ k-ft.

$\beta x = 0.4$ $\quad M = (234)(-0.450) = -105$ k-ft.

$\beta x = 0.8$ $\quad M = (234)(-0.0773) = -18.1$ k-ft.

$\beta x = 1.2$ $\quad M = (234)(0.230) = 53.9$ k-ft.

$\beta x = 1.6$ $\quad M = (234)(0.439) = 103$ k-ft.

$\beta x = 2.0$ $\quad M = (234)(0.539) = 126$ k-ft.

$\beta x = 2.4$ $\quad M = (234)(0.542) = 127$ k-ft.

The curves for the deflection, moment, and soil reaction due to the 60 kip load are plotted in Fig. 26. The slope and shear could also be computed and plotted in the same manner.

APPENDIX C

COEFFICIENTS FOR CHANGE IN PILE LENGTH

TABLE 1. COEFFICIENTS FOR DETERMINING THE LENGTH TO βL = 9.0

$$\alpha = (\beta' L')/(\beta'' L'')$$

α	L'/L"	α	L'/L"	α	L'/L"
.200	.27594	.400	.48044	.600	.66453
.205	.28145	.405	.48524	.610	.67338
.210	.28692	.410	.49003	.620	.68220
.215	.29238	.415	.49481	.630	.69099
.220	.29780	.420	.49957	.640	.69975
.225	.30321	.425	.50432	.650	.70848
.230	.30859	.430	.50906	.660	.71719
.235	.31394	.435	.51379	.670	.72587
.240	.31927	.440	.51851	.680	.73452
.245	.32458	.445	.52322	.690	.74315
.250	.32987	.450	.52792	.700	.75175
.255	.33514	.455	.53260	.710	.76033
.260	.34039	.460	.53728	.720	.76889
.265	.34561	.465	.54195	.730	.77742
.270	.35082	.470	.54661	.740	.78593
.275	.35601	.475	.55125	.750	.79441
.280	.36118	.480	.55589	.760	.80288
.285	.36633	.485	.56052	.770	.81132
.290	.37146	.490	.56514	.780	.81973
.295	.37658	.495	.56974	.790	.82813
.300	.38167	.500	.57434	.800	.83651
.305	.38675	.505	.57893	.810	.84486
.310	.39182	.510	.58352	.820	.85320
.315	.39687	.515	.58809	.830	.86151
.320	.40190	.520	.59265	.840	.86980
.325	.40691	.525	.59721	.850	.87808
.330	.41191	.530	.60175	.860	.88633
.335	.41690	.535	.60629	.870	.89457
.340	.42187	.540	.61082	.880	.90278
.345	.42683	.545	.61534	.890	.91098
.350	.43177	.550	.61985	.900	.91916
.355	.43669	.555	.62435	.910	.92732
.360	.44161	.560	.62885	.920	.93547
.365	.44651	.565	.63334	.930	.94359
.370	.45139	.570	.63782	.940	.95170
.375	.45627	.575	.64229	.950	.95979
.380	.46113	.580	.64675	.960	.96786
.385	.46598	.585	.65121	.970	.97592
.390	.47081	.590	.65566	.980	.98396
.395	.47563	.595	.66010	.990	.99199

APPENDIX D

RESULTS FOR PILES WITH A = 0.00

TABLE 2. COEFFICIENTS FOR PILE WITH POSITIVE MOMENT AT GROUND SURFACE

A = .00 K = (βX/8.0)K

βX	C_y	C_S	C_M	C_V	C_q	$K/K_{8.0}$
.00	-3.68196	2.13681	.00000	1.00000	.00000	.00000
.10	-3.46845	2.13171	.09970	.99098	.17342	.01250
.20	-3.25593	2.11682	.19768	.96587	.32559	.02500
.30	-3.04539	2.09229	.29243	.92660	.45680	.03750
.40	-2.83776	2.05850	.38263	.87524	.56755	.05000
.50	-2.63396	2.01597	.46716	.81379	.65849	.06250
.60	-2.43482	1.96529	.54513	.74421	.73044	.07500
.70	-2.24113	1.90719	.61581	.66834	.78479	.08750
.80	-2.05359	1.84241	.67866	.58793	.82143	.10000
.90	-1.87283	1.77175	.73331	.50461	.84277	.11250
1.00	-1.69940	1.69605	.77954	.41988	.84970	.12500
1.10	-1.53375	1.61614	.81728	.33513	.84356	.13750
1.20	-1.37627	1.53289	.84660	.25158	.82576	.15000
1.30	-1.22725	1.44711	.86767	.17034	.79771	.16250
1.40	-1.08690	1.35963	.88077	.09235	.76083	.17500
1.50	-.95535	1.27123	.88627	.01844	.71651	.18750
1.60	-.83266	1.18263	.88461	-.05073	.66613	.20000
1.70	-.71881	1.09454	.87629	-.11461	.61059	.21250
1.80	-.61372	1.00759	.86186	-.17280	.55234	.22500
1.90	-.51724	.92236	.84192	-.22500	.49138	.23750
2.00	-.42917	.83938	.81706	-.27103	.42917	.25000
2.10	-.34928	.75910	.78790	-.31083	.36674	.26250
2.20	-.27725	.68193	.75508	-.34441	.30498	.27500
2.30	-.21278	.60819	.71921	-.37188	.24470	.28750
2.40	-.15550	.53817	.68089	-.39342	.18660	.30000
2.50	-.10502	.47208	.64071	-.40930	.13128	.31250
2.60	-.06095	.41008	.59920	-.41980	.07924	.32500
2.70	-.02287	.35227	.55690	-.42528	.03088	.33750
2.80	.00962	.29871	.51429	-.42612	-.01348	.35000
2.90	.03699	.24940	.47181	-.42273	-.05364	.36250
3.00	.05964	.20433	.42986	-.41554	-.08946	.37500
3.10	.07799	.16340	.38881	-.40490	-.12068	.38750
3.20	.09245	.12652	.34895	-.39152	-.14792	.40000
3.30	.10342	.09356	.31058	-.37556	-.17064	.41250
3.40	.11128	.06434	.27391	-.35754	-.18917	.42500
3.50	.11640	.03871	.23912	-.33786	-.20370	.43750
3.60	.11913	.01645	.20637	-.31693	-.21443	.45000
3.70	.11979	-.00263	.17576	-.29510	-.22161	.46250
3.80	.11869	-.01877	.14737	-.27272	-.22552	.47500
3.90	.11612	-.03219	.12122	-.25011	-.22643	.48750
4.00	.11233	-.04312	.09734	-.22753	-.22467	.50000

TABLE 3. COEFFICIENTS FOR PILE WITH POSITIVE MOMENT AT GROUND SURFACE

A = .00 R = 5.00 T = 2.825

β^*	C_y	C_S	C_M	C_V	C_q	$K/K_{8.0}$
.00	-4.32972	2.44613	.00000	1.00000	-.00000	-.00000
.10	-4.08527	2.44103	.09997	.99877	.03368	.00206
.20	-3.84183	2.42604	.19956	.99147	.11805	.00768
.30	-3.60037	2.40116	.29795	.97412	.23198	.01610
.40	-3.36190	2.36654	.39400	.94462	.35899	.02669
.50	-3.12736	2.32249	.48647	.90230	.48662	.03890
.60	-2.89768	2.26942	.57408	.84759	.60583	.05226
.70	-2.67374	2.20788	.65564	.78166	.71044	.06642
.80	-2.45635	2.13854	.73011	.70616	.79659	.08107
.90	-2.24626	2.06214	.79663	.62306	.86231	.09597
1.00	-2.04412	1.97952	.85455	.53444	.90706	.11093
1.10	-1.85052	1.89155	.90341	.44237	.93138	.12582
1.20	-1.66595	1.79917	.94298	.34884	.93662	.14055
1.30	-1.49080	1.70329	.97319	.25566	.92459	.15505
1.40	-1.32537	1.60485	.99417	.16445	.89746	.16928
1.50	-1.16988	1.50478	1.00619	.07662	.85749	.18324
1.60	-1.02444	1.40392	1.00964	-.00667	.80698	.19693
1.70	-.88909	1.30313	1.00502	-.08448	.74816	.21037
1.80	-.76378	1.20318	.99294	-.15608	.68308	.22358
1.90	-.64840	1.10479	.97402	-.22095	.61367	.23660
2.00	-.54276	1.00860	.94897	-.27872	.54161	.24946
2.10	-.44660	.91519	.91850	-.32923	.46841	.26220
2.20	-.35962	.82506	.88335	-.37241	.39537	.27485
2.30	-.28147	.73866	.84425	-.40835	.32362	.28743
2.40	-.21176	.65633	.80190	-.43721	.25409	.29997
2.50	-.15007	.57837	.75702	-.45927	.18758	.31249
2.60	-.09594	.50499	.71025	-.47486	.12473	.32499
2.70	-.04892	.43636	.66223	-.48437	.06604	.33749
2.80	-.00852	.37257	.61355	-.48823	.01193	.35000
2.90	.02574	.31365	.56475	-.48693	-.03732	.36250
3.00	.05435	.25961	.51631	-.48095	-.08153	.37500
3.10	.07781	.21036	.46869	-.47080	-.12061	.38750
3.20	.09657	.16582	.42227	-.45701	-.15452	.40000
3.30	.11112	.12585	.37739	-.44008	-.18335	.41250
3.40	.12188	.09028	.33434	-.42051	-.20721	.42500
3.50	.12931	.05892	.29335	-.39880	-.22629	.43750
3.60	.13379	.03153	.25463	-.37541	-.24083	.45000
3.70	.13573	.00790	.21831	-.35079	-.25110	.46250
3.80	.13548	-.01222	.18450	-.32533	-.25742	.47500
3.90	.13339	-.02909	.15326	-.29943	-.26011	.48750
4.00	.12976	-.04299	.12461	-.27342	-.25952	.50000

TABLE 4. COEFFICIENTS FOR PILE WITH POSITIVE MOMENT AT GROUND SURFACE

A = .00 R = 2.75 T = 2.925

βx	C_y	C_S	C_M	C_V	C_q	$K/K_{8.0}$
.00	-4.98643	2.71902	.00000	1.00000	-.00010	-.00000
.10	-4.71470	2.71391	.09998	.99922	.02150	.00114
.20	-4.44396	2.69892	.19972	.99444	.07864	.00442
.30	-4.17522	2.67340	.29865	.98260	.16120	.00965
.40	-3.90947	2.63925	.39595	.96162	.26007	.01663
.50	-3.64767	2.59493	.49065	.93029	.36733	.02517
.60	-3.39078	2.54125	.58167	.88810	.47618	.03510
.70	-3.13970	2.47873	.66793	.83519	.58096	.04625
.80	-2.89529	2.40787	.74839	.77221	.67712	.05846
.90	-2.65837	2.32930	.82209	.70020	.76110	.07157
1.00	-2.42965	2.24375	.88819	.62051	.83036	.08544
1.10	-2.20981	2.15195	.94600	.53471	.88324	.09992
1.20	-1.99943	2.05484	.99499	.44448	.91886	.11489
1.30	-1.79899	1.95328	1.03481	.35155	.93710	.13022
1.40	-1.60888	1.84821	1.06527	.25766	.93838	.14581
1.50	-1.42942	1.74057	1.08637	.16444	.92369	.16154
1.60	-1.26082	1.63126	1.09823	.07344	.89437	.17733
1.70	-1.10319	1.52123	1.10116	-.01398	.85209	.19309
1.80	-.95657	1.41133	1.09559	-.09650	.79872	.20874
1.90	-.82090	1.30239	1.08203	-.17340	.73624	.22421
2.00	-.69604	1.19520	1.06111	-.24359	.66668	.23945
2.10	-.58179	1.09041	1.03354	-.30656	.59207	.25441
2.20	-.47786	.98869	1.00004	-.36189	.51430	.26906
2.30	-.38393	.89058	.96141	-.40937	.43519	.28337
2.40	-.29962	.79656	.91842	-.44894	.35635	.29733
2.50	-.22448	.70703	.87186	-.48070	.27921	.31094
2.60	-.15806	.62229	.82251	-.50489	.20499	.32422
2.70	-.09987	.54259	.77111	-.52184	.13470	.33720
2.80	-.04938	.46811	.71836	-.53190	.06912	.34993
2.90	-.00608	.39895	.66491	-.53585	.00881	.36249
3.00	.03057	.33514	.61137	-.53396	-.04585	.37500
3.10	.06111	.27666	.55828	-.52689	-.09472	.38750
3.20	.08606	.22345	.50613	-.51522	-.13771	.40000
3.30	.10596	.17538	.45536	-.49955	-.17484	.41250
3.40	.12130	.13231	.40633	-.48046	-.20621	.42500
3.50	.13257	.09405	.35936	-.45851	-.23201	.43750
3.60	.14025	.06036	.31470	-.43424	-.25246	.45000
3.70	.14478	.03102	.27257	-.40819	-.26785	.46250
3.80	.14658	.00575	.23310	-.38084	-.27851	.47500
3.90	.14605	-.01570	.19642	-.35264	-.28480	.48750
4.00	.14355	-.03366	.16259	-.32402	-.28711	.50000

TABLE 5. COEFFICIENTS FOR PILE WITH POSITIVE MOMENT AT GROUND SURFACE

A = .00 B = 1.80 T = 3.025

βx	C_y	C_S	C_M	C_V	C_q	$K/K_{8.0}$
.00	-5.70257	2.99398	.00000	1.00000	-.00000	-.00000
.10	-5.40333	2.98888	.09999	.99943	.01586	.00073
.20	-5.10510	2.97389	.19979	.99586	.05914	.00289
.30	-4.80887	2.94894	.29899	.98685	.12362	.00642
.40	-4.51562	2.91413	.39693	.97059	.20348	.01126
.50	-4.22634	2.86963	.49284	.94580	.29333	.01735
.60	-3.94199	2.81567	.58580	.91174	.38824	.02462
.70	-3.66349	2.75260	.67489	.86813	.48382	.03301
.80	-3.39174	2.68086	.75913	.81509	.57620	.04247
.90	-3.12758	2.60098	.83763	.75312	.66205	.05292
1.00	-2.87178	2.51358	.90950	.68301	.73865	.06430
1.10	-2.62507	2.41934	.97401	.60580	.80380	.07655
1.20	-2.38810	2.31906	1.03048	.52271	.85586	.08959
1.30	-2.16143	2.21355	1.07841	.43512	.89375	.10337
1.40	-1.94553	2.10369	1.11741	.34448	.91686	.11781
1.50	-1.74080	1.99040	1.14725	.25228	.92506	.13285
1.60	-1.54753	1.87457	1.16786	.15999	.91865	.14840
1.70	-1.36593	1.75715	1.17929	.06904	.89830	.16441
1.80	-1.19612	1.63903	1.18175	-.01921	.86498	.18078
1.90	-1.03812	1.52110	1.17557	-.10354	.81997	.19746
2.00	-.89187	1.40421	1.16120	-.18285	.76472	.21436
2.10	-.75722	1.28913	1.13919	-.25618	.70086	.23139
2.20	-.63396	1.17662	1.11018	-.32277	.63009	.24847
2.30	-.52180	1.06732	1.07487	-.38202	.55420	.26552
2.40	-.42038	.96184	1.03402	-.43349	.47493	.28244
2.50	-.32929	.86069	.98842	-.47695	.39412	.29913
2.60	-.24809	.76429	.93888	-.51230	.31309	.31550
2.70	-.17627	.67302	.88621	-.53962	.23368	.33141
2.80	-.11332	.58714	.81210	-.55914	.15717	.34674
2.90	-.05867	.50684	.77462	-.57120	.08480	.36132
3.00	-.01177	.43224	.71718	-.57629	.01766	.37493
3.10	.02795	.36341	.65956	-.57495	-.04332	.38750
3.20	.06108	.30032	.60237	-.56785	-.09773	.40000
3.30	.08819	.24290	.54615	-.55564	-.14551	.41250
3.40	.10983	.19104	.49138	-.53898	-.18672	.42500
3.50	.12656	.14456	.43847	-.51852	-.22149	.43750
3.60	.13891	.10326	.38777	-.49490	-.25004	.45000
3.70	.14737	.06692	.33957	-.46873	-.27264	.46250
3.80	.15244	.03525	.29409	-.44057	-.28964	.47500
3.90	.15456	.00800	.25150	-.41098	-.30140	.48750
4.00	.15417	-.01519	.21192	-.38047	-.30834	.50000

TABLE 6. COEFFICIENTS FOR PILE WITH POSITIVE MOMENT AT GROUND SURFACE

A = .00 R = 1.35 T = 3.125

βx	C_y	C_S	C_M	C_V	C_q	$K/K_{8.0}$
.00	-6.35415	3.23002	.00000	1.00000	-.00000	-.00000
.10	-6.03132	3.22491	.09999	.99954	.01295	.00053
.20	-5.70948	3.20992	.19983	.99660	.04876	.00213
.30	-5.38965	3.18496	.29917	.98913	.10297	.00477
.40	-5.07280	3.15012	.39746	.97551	.17127	.00844
.50	-4.75993	3.10556	.49404	.95452	.24957	.01310
.60	-4.45199	3.05140	.58811	.92537	.33402	.01875
.70	-4.14994	2.98803	.67884	.88762	.42108	.02536
.80	-3.85466	2.91578	.76536	.84118	.50751	.03291
.90	-3.56704	2.83513	.84681	.78625	.59039	.04137
1.00	-3.28788	2.74666	.92236	.72331	.66721	.05073
1.10	-3.01794	2.65090	.99125	.65310	.73580	.06095
1.20	-2.75791	2.54864	1.05278	.57651	.79441	.07201
1.30	-2.50839	2.44062	1.10638	.49462	.84165	.08388
1.40	-2.26994	2.32766	1.15158	.40861	.87654	.09653
1.50	-2.04299	2.21064	1.18802	.31977	.89847	.10994
1.60	-1.82791	2.09038	1.21548	.22939	.90718	.12407
1.70	-1.62498	1.96784	1.23389	.13880	.90275	.13888
1.80	-1.43439	1.84392	1.24327	.04929	.88558	.15434
1.90	-1.25622	1.71950	1.24382	-.03789	.85633	.17041
2.00	-1.09047	1.59548	1.23581	-.12158	.81592	.18705
2.10	-.93708	1.47263	1.21964	-.20072	.76547	.20421
2.20	-.79589	1.35180	1.19583	-.27437	.70624	.22184
2.30	-.66664	1.23371	1.16497	-.34171	.63965	.23987
2.40	-.54904	1.11904	1.12771	-.40209	.56718	.25826
2.50	-.44270	1.00839	1.08478	-.45499	.49037	.27691
2.60	-.34722	.90225	1.03696	-.50007	.41077	.29575
2.70	-.26210	.80113	.98502	-.53710	.32990	.31466
2.80	-.18682	.70537	.92979	-.56605	.24924	.33351
2.90	-.12085	.61526	.87206	-.58701	.17021	.35210
3.00	-.06359	.53102	.81263	-.60020	.09415	.37013
3.10	-.01446	.45277	.75225	-.60599	.02238	.38692
3.20	.02715	.38057	.69165	-.60489	-.04344	.40000
3.30	.06184	.31442	.63147	-.59756	-.10204	.41250
3.40	.09022	.25424	.57231	-.58474	-.15337	.42500
3.50	.11287	.19991	.51467	-.56714	-.19753	.43750
3.60	.13038	.15124	.45901	-.54548	-.23468	.45000
3.70	.14329	.10802	.40568	-.52044	-.26509	.46250
3.80	.15214	.07001	.35500	-.49269	-.28908	.47500
3.90	.15745	.03692	.30721	-.46284	-.30702	.48750
4.00	.15967	.00842	.26248	-.43149	-.31935	.50000

TABLE 7. COEFFICIENTS FOR PILE WITH POSITIVE MOMENT AT GROUND SURFACE

A = .00 R = 1.05 T = 3.250

βX	C_y	C_S	C_M	C_V	C_q	$K/K_{8.0}$
.00	-7.07457	3.47881	.00000	1.00000	-.00000	-.00000
.10	-6.72686	3.47369	.09999	.99961	.01085	.00040
.20	-6.38015	3.45870	.19986	.99714	.04116	.00161
.30	-6.03543	3.43374	.29930	.99081	.08753	.00362
.40	-5.69371	3.39887	.39785	.97918	.14668	.00644
.50	-5.35596	3.35435	.49493	.96113	.21542	.01005
.60	-5.02316	3.29996	.58985	.93586	.29068	.01446
.70	-4.69626	3.23635	.68186	.90287	.36957	.01967
.80	-4.37617	3.16372	.77018	.86192	.44939	.02567
.90	-4.06378	3.08247	.85400	.81304	.52767	.03246
1.00	-3.75992	2.99323	.93255	.75652	.60216	.04003
1.10	-3.46539	2.89618	1.00508	.69282	.67087	.04839
1.20	-3.18090	2.79233	1.07091	.62261	.73211	.05753
1.30	-2.90712	2.68226	1.12942	.54671	.78444	.06745
1.40	-2.64462	2.56672	1.18010	.46607	.82673	.07815
1.50	-2.39392	2.44664	1.22252	.38175	.85813	.08961
1.60	-2.15543	2.32252	1.25637	.29485	.87808	.10184
1.70	-1.92950	2.19557	1.28145	.20655	.88631	.11483
1.80	-1.71638	2.06655	1.29767	.11801	.88281	.12858
1.90	-1.51623	1.93635	1.30508	.03039	.86780	.14308
2.00	-1.32912	1.80592	1.30381	-.05517	.84177	.15833
2.10	-1.15504	1.67589	1.29414	-.13759	.80537	.17431
2.20	-.99390	1.54730	1.27642	-.21590	.75947	.19103
2.30	-.84551	1.42087	1.25112	-.28919	.70507	.20847
2.40	-.70963	1.29733	1.21877	-.35666	.64329	.22662
2.50	-.58593	1.17740	1.17999	-.41763	.57534	.24548
2.60	-.47403	1.06154	1.13546	-.47155	.50252	.26502
2.70	-.37348	.95043	1.08591	-.51801	.42612	.28523
2.80	-.28378	.84451	1.03210	-.55670	.34746	.30610
2.90	-.20440	.74414	.97482	-.58747	.26783	.32757
3.00	-.13477	.64967	.91486	-.61028	.18847	.34962
3.10	-.07428	.56123	.85301	-.62521	.11058	.37216
3.20	-.02232	.47908	.79006	-.63248	.03528	.39500
3.30	.02172	.40324	.72675	-.63241	-.03584	.41250
3.40	.05851	.33371	.66379	-.62559	-.09947	.42500
3.50	.08866	.27046	.60181	-.61280	-.15516	.43750
3.60	.11279	.21330	.54139	-.59483	-.20303	.45000
3.70	.13151	.16210	.48299	-.57246	-.24329	.46250
3.80	.14539	.11662	.42701	-.54643	-.27625	.47500
3.90	.15500	.07660	.37379	-.51746	-.30226	.48750
4.00	.16087	.04170	.32359	-.48623	-.32175	.50000

APPENDIX E

RESULTS FOR PILES WITH A = 0.50

TABLE 8. COEFFICIENTS FOR PILE WITH POSITIVE MOMENT AT GROUND SURFACE

A = .50 K = (βX/8.0)K

βx	C_y	C_S	C_M	C_V	C_q	$K/K_{8.0}$
.00	-4.75037	3.14006	.50000	1.00000	.00000	.00000
.10	-4.43903	3.08497	.59961	.98842	.22195	.01250
.20	-4.13368	3.02011	.69704	.95644	.41336	.02500
.30	-3.83530	2.94571	.79035	.90680	.57529	.03750
.40	-3.54482	2.86225	.87793	.84238	.70896	.05000
.50	-3.26312	2.77038	.95845	.76595	.81578	.06250
.60	-2.99099	2.67084	1.03083	.68012	.89729	.07500
.70	-2.72916	2.56452	1.09426	.58733	.95520	.08750
.80	-2.47826	2.45233	1.14815	.48985	.99130	.10000
.90	-2.23884	2.33524	1.19215	.38977	1.00748	.11250
1.00	-2.01134	2.21426	1.22609	.28890	1.00567	.12500
1.10	-1.79608	2.09038	1.24998	.18921	.98784	.13750
1.20	-1.59332	1.96461	1.26401	.09192	.95599	.15000
1.30	-1.40319	1.83791	1.26848	-.00155	.91207	.16250
1.40	-1.22574	1.71123	1.26385	-.09013	.85811	.17500
1.50	-1.06091	1.58545	1.25064	-.17287	.79568	.18750
1.60	-.90859	1.46138	1.22948	-.24903	.72687	.20000
1.70	-.76856	1.33981	1.20106	-.31807	.65327	.21250
1.80	-.64053	1.22140	1.16610	-.37958	.57648	.22500
1.90	-.52416	1.10679	1.12538	-.43331	.49795	.23750
2.00	-.41904	.99651	1.07969	-.47915	.41904	.25000
2.10	-.32471	.89100	1.02980	-.51714	.34094	.26250
2.20	-.24067	.79066	.97650	-.54741	.26474	.27500
2.30	-.16640	.69580	.92055	-.57010	.19136	.28750
2.40	-.10133	.60662	.86268	-.58581	.12160	.30000
2.50	-.04489	.52330	.80360	-.59467	.05612	.31250
2.60	.00350	.44592	.74394	-.59721	-.00456	.32500
2.70	.04447	.37451	.68434	-.59394	-.06004	.33750
2.80	.07859	.30903	.62532	-.58539	-.11003	.35000
2.90	.10646	.24941	.56740	-.57213	-.15437	.36250
3.00	.12866	.19550	.51102	-.55472	-.19299	.37500
3.10	.14574	.14713	.45657	-.53373	-.22590	.38750
3.20	.15825	.10410	.40437	-.50974	-.25321	.40000
3.30	.16672	.06617	.35470	-.48328	-.27509	.41250
3.40	.17164	.03307	.30777	-.45490	-.29179	.42500
3.50	.17348	.00451	.26376	-.42510	-.30359	.43750
3.60	.17267	-.01978	.22278	-.39435	-.31082	.45000
3.70	.16964	-.04014	.18491	-.36308	-.31384	.46250
3.80	.16476	-.05688	.15017	-.33171	-.31305	.47500
3.90	.15837	-.07029	.11856	-.30059	-.30883	.48750
4.00	.15079	-.08073	.09003	-.27004	-.30159	.50000

TABLE 9. COEFFICIENTS FOR PILE WITH POSITIVE MOMENT AT GROUND SURFACE

A = .50 R = 5.00 T = 2.675

βx	C_y	C_S	C_M	C_V	C_q	$K/K_{8.0}$
.00	-5.49425	3.49901	.50000	1.00000	-.00000	-.00000
.10	-5.14702	3.44390	.59996	.99837	.04463	.00216
.20	-4.80578	3.37893	.69942	.98876	.15472	.00804
.30	-4.47154	3.30407	.79730	.96616	.30069	.01681
.40	-4.14527	3.21957	.89217	.92815	.46018	.02775
.50	-3.82792	3.12584	.98243	.87423	.61690	.04028
.60	-3.52038	3.02330	1.06654	.80527	.75950	.05393
.70	-3.22351	2.91276	1.14307	.72309	.88070	.06830
.80	-2.93806	2.79500	1.21082	.63004	.97638	.08308
.90	-2.66470	2.67094	1.26883	.52878	1.04486	.09802
1.00	-2.40403	2.54163	1.31640	.42202	1.08630	.11296
1.10	-2.15651	2.40805	1.35314	.31242	1.10215	.12777
1.20	-1.92252	2.27137	1.37888	.20242	1.09471	.14235
1.30	-1.70230	2.13266	1.39368	.09420	1.06679	.15666
1.40	-1.49602	1.99301	1.39783	-.01032	1.02145	.17069
1.50	-1.30370	1.85348	1.39178	-.10958	.96178	.18443
1.60	-1.12529	1.71500	1.37612	-.20228	.89079	.19790
1.70	-.96063	1.57855	1.35156	-.28744	.81129	.21113
1.80	-.80949	1.44497	1.31889	-.36433	.72581	.22415
1.90	-.67153	1.31503	1.27897	-.43247	.63665	.23701
2.00	-.54635	1.18942	1.23268	-.49160	.54579	.24974
2.10	-.43349	1.06869	1.18093	-.54163	.45496	.26237
2.20	-.33244	.95338	1.12464	-.58264	.36562	.27495
2.30	-.24263	.84389	1.06468	-.61485	.27901	.28748
2.40	-.16347	.74054	1.00193	-.63858	.19616	.29999
2.50	-.09432	.64358	.93722	-.65425	.11791	.31249
2.60	-.03455	.55314	.87132	-.66235	.04492	.32500
2.70	.01650	.46932	.80497	-.66344	-.02228	.33750
2.80	.05951	.39214	.73883	-.65811	-.08332	.35000
2.90	.09513	.32153	.67353	-.64700	-.13795	.36250
3.00	.12402	.25739	.60959	-.63075	-.18603	.37500
3.10	.14681	.19955	.54751	-.61003	-.22756	.38750
3.20	.16412	.14780	.48771	-.58547	-.26260	.40000
3.30	.17655	.10191	.43052	-.55773	-.29132	.41250
3.40	.18468	.06160	.37624	-.52742	-.31396	.42500
3.50	.18904	.02655	.32510	-.49514	-.33082	.43750
3.60	.19014	-.00354	.27726	-.46145	-.34226	.45000
3.70	.18847	-.02902	.23284	-.42687	-.34868	.46250
3.80	.18447	-.05023	.19190	-.39187	-.35050	.47500
3.90	.17855	-.06752	.15446	-.35691	-.34818	.48750
4.00	.17108	-.08128	.12050	-.32236	-.34217	.50000

TABLE 10. COEFFICIENTS FOR PILE WITH POSITIVE MOMENT AT GROUND SURFACE

A = .50 B = 2.75 T = 2.775

βY	C_y	C_S	C_M	C_V	C_q	$K/K_{8.0}$
.00	-6.24681	3.81694	.50000	1.00000	-.00000	-.00000
.10	-5.86779	3.76183	.59998	.99898	.02816	.00120
.20	-5.49476	3.69685	.69963	.99275	.10216	.00464
.30	-5.12873	3.62194	.79824	.97744	.20766	.01012
.40	-4.77068	3.53728	.89475	.95054	.33224	.01741
.50	-4.42157	3.44312	.98794	.91069	.46530	.02630
.60	-4.08234	3.33985	1.07647	.85749	.59798	.03662
.70	-3.75387	3.22803	1.15903	.79134	.72314	.04815
.80	-3.43698	3.10830	1.23437	.71333	.83519	.06075
.90	-3.13243	2.98145	1.30137	.62493	.93000	.07422
1.00	-2.84088	2.84836	1.35909	.52804	1.00477	.08842
1.10	-2.56292	2.70999	1.40678	.42474	1.05791	.10319
1.20	-2.29902	2.56737	1.44391	.31724	1.08884	.11840
1.30	-2.04955	2.42159	1.47017	.20775	1.09790	.13392
1.40	-1.81477	2.27373	1.48546	.09840	1.08614	.14962
1.50	-1.59483	2.12489	1.48992	-.00880	1.05521	.16541
1.60	-1.38979	1.97612	1.48383	-.11204	1.00720	.18117
1.70	-1.19957	1.82847	1.46768	-.20972	.94450	.19684
1.80	-1.02403	1.68292	1.44210	-.30051	.86970	.21232
1.90	-.86289	1.54036	1.40783	-.38333	.78545	.22756
2.00	-.71583	1.40163	1.36571	-.45736	.69438	.24250
2.10	-.58242	1.26747	1.31665	-.52205	.59901	.25712
2.20	-.46218	1.13851	1.26160	-.57709	.50169	.27137
2.30	-.35454	1.01532	1.20154	-.62240	.40454	.28525
2.40	-.25892	.89835	1.13743	-.65808	.30944	.29877
2.50	-.17467	.78795	1.07021	-.68441	.21795	.31195
2.60	-.10111	.68438	1.00082	-.70184	.13138	.32483
2.70	-.03757	.58783	.93011	-.71090	.05072	.33748
2.80	.01667	.49838	.85888	-.71222	-.02333	.35000
2.90	.06232	.41605	.78788	-.70648	-.09037	.36250
3.00	.10010	.34077	.71778	-.69440	-.15015	.37500
3.10	.13069	.27244	.64918	-.67671	-.20258	.38750
3.20	.15479	.21087	.58259	-.65415	-.24767	.40000
3.30	.17307	.15583	.51848	-.62743	-.28557	.41250
3.40	.18616	.10707	.45722	-.59728	-.31647	.42500
3.50	.19467	.06428	.39911	-.56437	-.34068	.43750
3.60	.19919	.02713	.34441	-.52937	-.35854	.45000
3.70	.20026	-.00473	.29328	-.49287	-.37049	.46250
3.80	.19840	-.03166	.24586	-.45546	-.37696	.47500
3.90	.19407	-.05404	.20220	-.41764	-.37845	.48750
4.00	.18772	-.07227	.16233	-.37993	-.37545	.50000

TABLE 11. COEFFICIENTS FOR PILE WITH POSITIVE MOMENT AT GROUND SURFACE

A = .50   R = 1.80   T = 2.900

βy	C_y	C_S	C_M	C_V	C_q	$K/K_{8.0}$
.00	-7.08752	4.14531	.50000	1.00000	-.00000	-.00000
.10	-6.67565	4.09020	.59998	.99927	.02043	.00076
.20	-6.26979	4.02521	.69973	.99468	.07567	.00301
.30	-5.87092	3.95028	.79870	.98320	.15714	.00669
.40	-5.48004	3.86553	.89609	.96260	.25695	.01172
.50	-5.09811	3.77117	.99089	.93142	.36793	.01804
.60	-4.72610	3.66748	1.08201	.88885	.48367	.02558
.70	-4.36490	3.55492	1.16830	.83471	.59856	.03428
.80	-4.01537	3.43403	1.24860	.76934	.70776	.04406
.90	-3.67833	3.30545	1.32184	.69350	.80724	.05486
1.00	-3.35450	3.16996	1.38701	.60835	.89375	.06660
1.10	-3.04453	3.02837	1.44326	.51530	.96482	.07922
1.20	-2.74899	2.88164	1.48988	.41600	1.01870	.09264
1.30	-2.46833	2.73075	1.52632	.31221	1.05434	.10678
1.40	-2.20293	2.57675	1.55223	.20570	1.07135	.12158
1.50	-1.95305	2.42069	1.56745	.09850	1.06988	.13695
1.60	-1.71882	2.26364	1.57198	-.00756	1.05064	.15281
1.70	-1.50032	2.10666	1.56603	-.11098	1.01476	.16909
1.80	-1.29746	1.95079	1.54993	-.20998	.96376	.18570
1.90	-1.11009	1.79702	1.52421	-.30323	.89943	.20255
2.00	-.93796	1.64627	1.48951	-.38947	.82380	.21957
2.10	-.78071	1.49941	1.44657	-.46767	.73904	.23665
2.20	-.63793	1.35722	1.39625	-.53703	.64740	.25370
2.30	-.50910	1.22039	1.33946	-.59698	.55112	.27063
2.40	-.39367	1.08952	1.27716	-.64717	.45244	.28732
2.50	-.29100	.96512	1.21033	-.68746	.35346	.30366
2.60	-.20043	.84758	1.13997	-.71792	.25617	.31952
2.70	-.12126	.73721	1.06705	-.73882	.16237	.33475
2.80	-.05275	.63423	.99250	-.75058	.07368	.34918
2.90	.00581	.53874	.91720	-.75370	-.00843	.36250
3.00	.05522	.45079	.84198	-.74917	-.08283	.37500
3.10	.09621	.37032	.76759	-.73751	-.14912	.38750
3.20	.12952	.29722	.69468	-.71963	-.20723	.40000
3.30	.15588	.23131	.62383	-.69635	-.25720	.41250
3.40	.17600	.17236	.55555	-.66847	-.29920	.42500
3.50	.19056	.12009	.49025	-.63679	-.33348	.43750
3.60	.20021	.07419	.42829	-.60204	-.36039	.45000
3.70	.20558	.03431	.36992	-.56495	-.38033	.46250
3.80	.20725	.00007	.31535	-.52620	-.39378	.47500
3.90	.20576	-.02890	.26471	-.48641	-.40124	.48750
4.00	.20162	-.05306	.21808	-.44614	-.40325	.50000

TABLE 12. COEFFICIENTS FOR PILE WITH POSITIVE MOMENT AT GROUND SURFACE

A = .50 R = 1.35 T = 3.000

βx	C_y	C_S	C_M	C_V	C_q	$K/K_{8.0}$
.00	-7.83486	4.42092	.50000	1.00000	-.00000	-.00000
.10	-7.39543	4.36582	.50909	.99941	.01654	.00055
.20	-6.96201	4.30083	.60978	.99567	.06191	.00222
.30	-6.53558	4.22588	.70894	.98622	.12997	.00497
.40	-6.11714	4.14109	.80679	.96908	.21492	.00878
.50	-5.70766	4.04662	.90247	.94283	.31132	.01363
.60	-5.30811	3.94270	1.08504	.90658	.41419	.01950
.70	-4.91941	3.82974	1.17346	.85092	.51897	.02637
.80	-4.54243	3.70819	1.25670	.80287	.62150	.03421
.90	-4.17802	3.57862	1.33372	.73581	.71848	.04299
1.00	-3.82693	3.44171	1.40357	.65940	.80659	.05269
1.10	-3.48988	3.29820	1.46536	.57489	.88339	.06328
1.20	-3.16748	3.14895	1.51833	.48327	.94688	.07473
1.30	-2.86024	2.99487	1.56184	.38604	.99556	.08701
1.40	-2.56862	2.83693	1.59541	.28472	1.02847	.10009
1.50	-2.29295	2.67616	1.61870	.18092	1.04568	.11394
1.60	-2.03345	2.51356	1.63156	.07628	1.04535	.12851
1.70	-1.79026	2.35021	1.63398	-.02758	1.02963	.14378
1.80	-1.56340	2.18713	1.62612	-.12910	.99865	.15969
1.90	-1.35279	2.02534	1.60828	-.22681	.95347	.17620
2.00	-1.15826	1.86582	1.58092	-.31934	.89542	.19326
2.10	-.97953	1.70947	1.54461	-.40549	.82615	.21082
2.20	-.81624	1.55718	1.50005	-.48421	.74711	.22882
2.30	-.66794	1.40972	1.44803	-.55464	.66043	.24719
2.40	-.53412	1.26781	1.38941	-.61610	.56796	.26584
2.50	-.41419	1.13205	1.32511	-.66810	.47164	.28468
2.60	-.30750	1.00295	1.25609	-.71036	.37342	.30359
2.70	-.21337	.88096	1.18334	-.74278	.27519	.32242
2.80	-.13108	.76638	1.10784	-.76546	.17877	.34095
2.90	-.05986	.65946	1.03055	-.77867	.08592	.35882
3.00	.00105	.56031	.95239	-.78284	-.00157	.37500
3.10	.05244	.46898	.87424	-.77863	-.08128	.38750
3.20	.09509	.38543	.79690	-.76689	-.15214	.40000
3.30	.12976	.30954	.72107	-.74851	-.21412	.41250
3.40	.15723	.24114	.64738	-.72438	-.26729	.42500
3.50	.17822	.17998	.57635	-.69536	-.31189	.43750
3.60	.19344	.12576	.50843	-.66229	-.34820	.45000
3.70	.20358	.07817	.44399	-.62600	-.37663	.46250
3.80	.20927	.03683	.38331	-.58723	-.39762	.47500
3.90	.21113	.00136	.32660	-.54672	-.41171	.48750
4.00	.20972	-.02869	.27400	-.50512	-.41944	.50000

TABLE 13. COEFFICIENTS FOR PILE WITH POSITIVE MOMENT AT GROUND SURFACE

A = .50 R = 1.05 T = 3.125

βx	C_y	C_S	C_M	C_V	C_q	$K/K_{8.0}$
.00	-8.65929	4.71093	.50000	1.00000	-.00000	-.00000
.10	-8.19086	4.65583	.59909	.99951	.01374	.00041
.20	-7.72844	4.59094	.69982	.99630	.05185	.00167
.30	-7.27301	4.51588	.79911	.98844	.10969	.00377
.40	-6.82557	4.43105	.89730	.97391	.18285	.00669
.50	-6.38710	4.33650	.99365	.95147	.26712	.01045
.60	-5.95857	4.23242	1.08732	.92023	.35852	.01504
.70	-5.54090	4.11915	1.17740	.87965	.45376	.02045
.80	-5.13501	3.99710	1.26295	.82955	.54825	.02669
.90	-4.74174	3.86676	1.34302	.77010	.64011	.03374
1.00	-4.36190	3.72873	1.41669	.70173	.72622	.04162
1.10	-3.99622	3.58368	1.48311	.62514	.80423	.05031
1.20	-3.64536	3.43239	1.54149	.54125	.87213	.05981
1.30	-3.30991	3.27569	1.59116	.45113	.92834	.07011
1.40	-2.99036	3.11448	1.63156	.35604	.97160	.08122
1.50	-2.68712	2.94973	1.66226	.25730	1.00187	.09313
1.60	-2.40050	2.78239	1.68295	.15633	1.01626	.10583
1.70	-2.13070	2.61349	1.69350	.05456	1.01703	.11933
1.80	-1.87782	2.44405	1.69388	-.04657	1.00355	.13360
1.90	-1.64187	2.27507	1.68424	-.14567	.97631	.14865
2.00	-1.42276	2.10755	1.66485	-.24138	.93647	.16448
2.10	-1.22029	1.94243	1.63611	-.33246	.88382	.18106
2.20	-1.03417	1.78063	1.59854	-.41776	.82074	.19840
2.30	-.86403	1.62301	1.55278	-.49627	.74821	.21648
2.40	-.70941	1.47034	1.49953	-.56712	.66771	.23530
2.50	-.56978	1.32335	1.43961	-.62959	.58080	.25483
2.60	-.44454	1.18263	1.37389	-.68311	.48910	.27505
2.70	-.33304	1.04874	1.30328	-.72730	.39427	.29595
2.80	-.23457	.92211	1.22873	-.76191	.29790	.31749
2.90	-.14838	.80310	1.15120	-.78688	.20157	.33961
3.00	-.07370	.69194	1.07166	-.80228	.10679	.36222
3.10	-.00974	.58880	.99104	-.80834	.01581	.38506
3.20	.04430	.49374	.91027	-.80548	-.07088	.40000
3.30	.08925	.40673	.83020	-.79451	-.14726	.41250
3.40	.12589	.32765	.75159	-.77637	-.21442	.42500
3.50	.15502	.25633	.67512	-.75204	-.27129	.43750
3.60	.17740	.19253	.60135	-.72244	-.31932	.45000
3.70	.19375	.13595	.53077	-.68849	-.35845	.46250
3.80	.20480	.08625	.46376	-.65105	-.38913	.47500
3.90	.21121	.04306	.40064	-.61094	-.41186	.48750
4.00	.21360	.00592	.34163	-.56895	-.42721	.50000

APPENDIX F

RESULTS FOR PILES WITH A = 1.00

TABLE 14. COEFFICIENTS FOR PILE WITH POSITIVE MOMENT AT GROUND SURFACE

A = 1.00 $K = (\beta X/8.0)K_{8.0}$

βX	C_y	C_S	C_M	C_V	C_q	$K/K_{8.0}$
.00	-5.81877	4.14332	1.00000	1.00000	.00000	.00000
.10	-5.40961	4.03823	1.09953	.98587	.27048	.01250
.20	-5.01143	3.92340	1.19639	.94701	.50114	.02500
.30	-4.62522	3.79913	1.28827	.88699	.69378	.03750
.40	-4.25188	3.66599	1.37324	.80953	.85037	.05000
.50	-3.89227	3.52479	1.44974	.71812	.97506	.06250
.60	-3.54715	3.37639	1.51653	.61603	1.06414	.07500
.70	-3.21719	3.22165	1.57271	.50632	1.12601	.08750
.80	-2.90294	3.06225	1.61765	.39178	1.16117	.10000
.90	-2.60486	2.89873	1.65099	.27494	1.17218	.11250
1.00	-2.32328	2.73247	1.67264	.15810	1.16164	.12500
1.10	-2.05841	2.56461	1.68268	.04328	1.13213	.13750
1.20	-1.81037	2.39633	1.68141	-.06773	1.08622	.15000
1.30	-1.57913	2.22871	1.66930	-.17346	1.02643	.16250
1.40	-1.36457	2.06283	1.64693	-.27262	.95520	.17500
1.50	-1.16647	1.89967	1.61501	-.36418	.87485	.18750
1.60	-.98452	1.74014	1.57435	-.44734	.78762	.20000
1.70	-.81831	1.58507	1.52582	-.52153	.69556	.21250
1.80	-.66734	1.43522	1.47034	-.58635	.60061	.22500
1.90	-.53108	1.29122	1.40885	-.64161	.50452	.23750
2.00	-.40890	1.15363	1.34231	-.68728	.40690	.25000
2.10	-.30014	1.02290	1.27169	-.72346	.31514	.26250
2.20	-.20409	.89940	1.19791	-.75042	.22450	.27500
2.30	-.12002	.78340	1.12188	-.76851	.13602	.28750
2.40	-.04717	.67507	1.04447	-.77820	.05660	.30000
2.50	.01523	.57453	.96649	-.78003	-.01904	.31250
2.60	.06797	.48177	.88869	-.77462	-.08637	.32500
2.70	.11183	.39675	.81177	-.76260	-.15097	.33750
2.80	.14756	.31936	.73635	-.74467	-.20659	.35000
2.90	.17593	.24941	.66300	-.72153	-.25511	.36250
3.00	.19767	.18667	.59219	-.69390	-.29651	.37500
3.10	.21349	.13087	.52433	-.66248	-.33091	.38750
3.20	.22406	.08169	.45979	-.62796	-.35849	.40000
3.30	.23002	.03878	.39882	-.59101	-.37954	.41250
3.40	.23200	.00179	.34164	-.55227	-.39440	.42500
3.50	.23056	-.02967	.28840	-.51233	-.40348	.43750
3.60	.22622	-.05602	.23919	-.47176	-.40721	.45000
3.70	.21950	-.07766	.19405	-.43106	-.40608	.46250
3.80	.21083	-.09498	.15297	-.39070	-.40058	.47500
3.90	.20062	-.10839	.11589	-.35108	-.39122	.48750
4.00	.18926	-.11833	.08272	-.31256	-.37652	.50000

TABLE 15. COEFFICIENTS FOR PILE WITH POSITIVE MOMENT AT GROUND SURFACE

A = 1.00 B = 5.00 T = 2.550

βx	C_y	C_S	C_M	C_V	C_q	$K/K_{8.0}$
.00	-6.64963	4.54748	1.00000	1.00000	-.00000	-.00000
.10	-6.20005	4.44238	1.09995	.99795	.05620	.00226
.20	-5.76147	4.32741	1.19927	.98591	.19317	.00838
.30	-5.33487	4.20259	1.29663	.95783	.37224	.01744
.40	-4.92125	4.06821	1.39025	.91099	.56488	.02869
.50	-4.52151	3.92478	1.47823	.84510	.75080	.04151
.60	-4.13656	3.77283	1.55871	.76155	.91645	.05538
.70	-3.76718	3.61332	1.63006	.66282	1.05351	.06991
.80	-3.41410	3.44720	1.69090	.55201	1.15775	.08477
.90	-3.07792	3.27555	1.74019	.43248	1.22796	.09973
1.00	-2.75912	3.09963	1.77723	.30759	1.26509	.11462
1.10	-2.45809	2.92056	1.80164	.18055	1.27158	.12932
1.20	-2.17507	2.73971	1.81336	.05424	1.25077	.14376
1.30	-1.91017	2.55833	1.81259	-.06878	1.20646	.15790
1.40	-1.66338	2.37762	1.79978	-.18636	1.14265	.17173
1.50	-1.43458	2.19880	1.77555	-.29675	1.06320	.18528
1.60	-1.22353	2.02289	1.74069	-.39858	.97180	.19856
1.70	-1.02988	1.85098	1.69613	-.49081	.87180	.21162
1.80	-.85318	1.68397	1.64285	-.57274	.76617	.22450
2J41	0J74342	2J63379	2J69243	0J75445	J76866	J34835
2.00	-.54844	1.36784	1.51441	-.70422	.54819	.24988
2.10	-.41912	1.22000	1.44142	-.75362	.44000	.26245
2.20	-.30421	1.07970	1.36402	-.79232	.33461	.27498
2.30	-.20293	.94731	1.28327	-.82069	.23337	.28749
2.40	-.11449	.82313	1.20019	-.83919	.13739	.29999
2.50	-.03804	.70733	1.11573	-.84839	.04756	.31250
2.60	.02723	.60000	1.03078	-.84894	-.03540	.32500
2.70	.08221	.50116	.94619	-.84157	-.11099	.33750
2.80	.12773	.41072	.86269	-.82702	-.17882	.35000
2.90	.16461	.32855	.78098	-.80608	-.23869	.36250
3.00	.19369	.25445	.70165	-.77956	-.29054	.37500
3.10	.21575	.18812	.62522	-.74826	-.33441	.38750
3.20	.23155	.12928	.55213	-.71296	-.37048	.40000
3.30	.24183	.07757	.48273	-.67443	-.39902	.41250
3.40	.24727	.03259	.41732	-.63341	-.42037	.42500
3.50	.24854	-.00605	.35610	-.59059	-.43495	.43750
3.60	.24625	-.03878	.29924	-.54664	-.44325	.45000
3.70	.24096	-.06605	.24679	-.50215	-.44578	.46250
3.80	.23320	-.08830	.19881	-.45767	-.44308	.47500
3.90	.22345	-.10597	.15524	-.41369	-.43573	.48750
4.00	.21214	-.11954	.11604	-.37065	-.42428	.50000

TABLE 16. COEFFICIENTS FOR PILE WITH POSITIVE MOMENT AT GROUND SURFACE

A = 1.00 R = 2.75 T = 2.650

βx	C_y	C_S	C_M	C_V	C_q	$K/K_{8.0}$
.00	-7.49310	4.90846	1.00000	1.00000	-.00000	-.00000
.10	-7.00742	4.80335	1.09997	.99873	.03517	.00125
.20	-6.53274	4.68837	1.19954	.99097	.12680	.00485
.30	-6.07006	4.56349	1.29781	.97203	.25618	.01055
.40	-5.62035	4.42900	1.39350	.93896	.40731	.01811
.50	-5.18457	4.28500	1.48511	.89028	.56679	.02733
.60	-4.76364	4.13208	1.57106	.82570	.72365	.03797
.70	-4.35841	3.97100	1.64978	.74595	.86920	.04985
.80	-3.96967	3.80243	1.71982	.65250	.99683	.06277
.90	-3.59813	3.62736	1.77991	.54738	1.10188	.07655
1.00	-3.24437	3.44687	1.82901	.43302	1.18137	.09103
1.10	-2.90889	3.26198	1.86631	.31207	1.23381	.10603
1.20	-2.59207	3.07401	1.89130	.18723	1.25901	.12142
1.30	-2.29415	2.88417	1.90372	.06120	1.25784	.13707
1.40	-2.01526	2.69371	1.90358	-.06347	1.23203	.15283
1.50	-1.75539	2.50392	1.89114	-.18442	1.18397	.16862
1.60	-1.51442	2.31590	1.86688	-.29958	1.11654	.18431
1.70	-1.29211	2.13091	1.83146	-.40716	1.03290	.19984
1.80	-1.08811	1.94998	1.78573	-.50570	.93636	.21513
1.90	-.90196	1.77410	1.73064	-.59409	.83023	.23011
2.00	-.73310	1.60416	1.66726	-.67152	.71773	.24475
2.10	-.58092	1.44090	1.59670	-.73752	.60189	.25902
2.20	-.44469	1.28502	1.52012	-.79188	.48543	.27290
2.30	-.32367	1.13705	1.43868	-.83467	.37080	.28640
2.40	-.21702	.99741	1.35354	-.86618	.26004	.29954
2.50	-.12391	.86645	1.26579	-.88687	.15483	.31238
2.60	-.43464	.74431	1.17648	-.89730	.56502	.32499
2.70	.02522	.63116	1.08660	-.89845	-.03465	.33750
2.80	.08304	.52698	.99706	-.89087	-.11626	.35000
2.90	.13090	.43171	.90867	-.87550	-.18980	.36250
3.00	.16966	.34519	.82218	-.85322	-.25449	.37500
3.10	.20020	.26718	.73822	-.82492	-.31031	.38750
3.20	.22335	.19743	.65735	-.79147	-.35737	.40000
3.30	.23993	.13559	.58006	-.75375	-.39589	.41250
3.40	.25071	.08128	.50671	-.71258	-.42620	.42500
3.50	.25641	.03410	.43762	-.66878	-.44872	.43750
3.60	.25774	-.00640	.37301	-.62310	-.46393	.45000
3.70	.25533	-.04067	.31304	-.57624	-.47236	.46250
3.80	.24978	-.06918	.25778	-.52884	-.47460	.47500
3.90	.24166	-.09240	.20727	-.48151	-.47124	.48750
4.00	.23146	-.11084	.16146	-.43476	-.46292	.50000

TABLE 17. COEFFICIENTS FOR PILE WITH POSITIVE MOMENT AT GROUND SURFACE

A = 1.00 R = 1.80 T = 2.775

βx	C_y	C_S	C_M	C_V	C_q	$K/K_{8.0}$
.00	-8.43618	5.28226	1.00000	1.00000	-.00000	-.00000
.10	-7.91312	5.17715	1.09998	.99909	.02529	.00079
.20	-7.40106	5.06217	1.19967	.99343	.09323	.00314
.30	-6.90100	4.93725	1.29840	.97933	.19265	.00697
.40	-6.41392	4.80256	1.39519	.95414	.31344	.01221
.50	-5.94078	4.65838	1.48883	.91620	.44652	.01879
.60	-5.48254	4.50495	1.57800	.86469	.58390	.02662
.70	-5.04006	4.34294	1.66134	.79952	.71866	.03564
.80	-4.61420	4.17294	1.73749	.72125	.84498	.04578
.90	-4.20570	3.99574	1.80521	.63090	.95806	.05695
1.00	-3.81525	3.81227	1.86336	.53024	1.05417	.06907
1.10	-3.44342	3.62344	1.91099	.42085	1.13056	.08208
1.20	-3.09069	3.43044	1.94733	.30489	1.18539	.09588
1.30	-2.75743	3.23439	1.97183	.18457	1.21772	.11040
1.40	-2.44387	3.03650	1.98418	.06215	1.22737	.12555
1.50	-2.15014	2.83802	1.98427	-.06012	1.21489	.14125
1.60	-1.87625	2.64008	1.97223	-.18008	1.18142	.15741
1.70	-1.62207	2.44396	1.94839	-.29572	1.12864	.17395
1.80	-1.38737	2.25080	1.91328	-.40520	1.05862	.19076
1.90	-1.17178	2.06168	1.86759	-.50692	.97378	.20775
2.00	-.97487	1.87765	1.81218	-.59952	.87673	.22483
2.10	-.79607	1.69956	1.74801	-.68193	.77026	.24189
2.20	-.63474	1.52830	1.67614	-.75334	.65715	.25882
2.30	-.49017	1.36457	1.59770	-.81323	.54019	.27551
2.40	-.36158	1.20895	1.51386	-.86134	.42207	.29182
2.50	-.24811	1.06196	1.42580	-.89769	.30531	.30762
2.60	-.14891	.92390	1.33468	-.92253	.19224	.32275
2.70	-.06304	.79508	1.24164	-.93634	.08498	.33699
2.80	.01039	.67561	1.14774	-.93980	-.01455	.35000
2.90	.07236	.56553	1.05397	-.93376	-.10493	.36250
3.00	.12379	.46478	.96125	-.91916	-.18569	.37500
3.10	.16561	.37321	.87038	-.89697	-.25669	.38750
3.20	.19871	.29061	.78207	-.86816	-.31794	.40000
3.30	.22400	.21669	.69692	-.83372	-.36960	.41250
3.40	.24231	.15109	.61547	-.79457	-.41193	.42500
3.50	.25447	.09345	.53813	-.75165	-.44532	.43750
3.60	.26124	.04331	.46523	-.70581	-.47023	.45000
3.70	.26335	.00023	.39703	-.65788	-.48721	.46250
3.80	.26149	-.03627	.33370	-.60863	-.49684	.47500
3.90	.25629	-.06668	.27533	-.55875	-.49978	.48750
4.00	.24834	-.09156	.22195	-.50888	-.49668	.50000

TABLE 18. COEFFICIENTS FOR PILE WITH POSITIVE MOMENT AT GROUND SURFACE

A = 1.00 B = 1.35 T = 2.900

β x	C_y	C_S	C_M	C_V	C_q	$K/K_{8.0}$
.00	-9.30501	5.60701	1.00000	1.00000	-.00000	-.00000
.10	-8.74948	5.50190	1.09998	.99927	.02024	.00057
.20	-8.20494	5.38691	1.19973	.99471	.07545	.00229
.30	-7.67240	5.26198	1.29871	.98322	.15774	.00514
.40	-7.15285	5.12723	1.39609	.96247	.25974	.00907
.50	-6.64726	4.98291	1.49086	.93082	.37466	.01409
.60	-6.15657	4.82919	1.58188	.88730	.49628	.02015
.70	-5.68170	4.66666	1.66793	.83152	.61903	.02723
.80	-5.22350	4.49582	1.74780	.76362	.73801	.03532
.90	-4.78277	4.31736	1.82030	.68420	.84894	.04437
1.00	-4.36024	4.13210	1.88431	.59425	.94826	.05436
1.10	-3.95654	3.94083	1.93886	.49507	1.03306	.06527
1.20	-3.57223	3.74466	1.98309	.38823	1.10111	.07706
1.30	-3.20773	3.54460	2.01632	.27549	1.15083	.08969
1.40	-2.86339	3.34180	2.03806	.15875	1.18125	.10313
1.50	-2.53942	3.13745	2.04800	.03994	1.19199	.11734
1.60	-2.23592	2.93262	2.04604	-.07896	1.18321	.13229
1.70	-1.95287	2.72862	2.03227	-.19603	1.15557	.14793
1.80	-1.69014	2.52658	2.00695	-.30948	1.11015	.16421
1.90	-1.44746	2.32762	1.97055	-.41749	1.04843	.18108
2.00	-1.22448	2.13286	1.92367	-.51862	.97216	.19848
2.10	-1.02073	1.94323	1.86708	-.61148	.88338	.21636
2.20	-.83564	1.75974	1.80167	-.69493	.78429	.23463
2.30	-.66856	1.58318	1.72842	-.76805	.67720	.25323
2.40	-.51876	1.41429	1.64840	-.83017	.56450	.27204
2.50	-.38544	1.25371	1.56275	-.88084	.44858	.29095
2.60	-.26775	1.10190	1.47260	-.91986	.33180	.30980
2.70	-.16478	.95930	1.37914	-.94725	.21643	.32837
2.80	-.07559	.82615	1.28351	-.96328	.10471	.34628
2.90	.00075	.70263	1.18682	-.96840	-.00108	.36250
3.00	.06523	.58880	1.09014	-.96338	-.09784	.37500
3.10	.11881	.48457	.99443	-.94920	-.18415	.38750
3.20	.16244	.38984	.90056	-.92692	-.25991	.40000
3.30	.19706	.30437	.80927	-.89759	-.32516	.41250
3.40	.22359	.22787	.72123	-.86226	-.38011	.42500
3.50	.24291	.15999	.63697	-.82192	-.42509	.43750
3.60	.25585	.10032	.55697	-.77758	-.46054	.45000
3.70	.26322	.04843	.48156	-.73014	-.48696	.46250
3.80	.26577	.00384	.41101	-.68048	-.50497	.47500
3.90	.26421	-.03395	.34550	-.62942	-.51521	.48750
4.00	.25918	-.06550	.28515	-.57769	-.51837	.50000

TABLE 19. COEFFICIENTS FOR PILE WITH POSITIVE MOMENT AT GROUND SURFACE

A = 1.00 R = 1.05 T = 3.025

βx	C_y	C_S	C_M	C_V	C_q	$K/K_{8.0}$
.00	-10.23328	5.93815	1.00000	1.00000	-.00000	-.00000
.10	-9.64462	5.83304	1.09999	.99940	.01672	.00043
.20	-9.06698	5.71805	1.19978	.99561	.06283	.00173
.30	-8.50133	5.59311	1.29893	.98600	.13244	.00389
.40	-7.94866	5.45831	1.39673	.96849	.21996	.00691
.50	-7.40996	5.31390	1.49233	.94156	.32010	.01079
.60	-6.88619	5.15996	1.58472	.90420	.42796	.01553
.70	-6.37825	4.99705	1.67282	.85586	.53901	.02112
.80	-5.88704	4.82559	1.75554	.79443	.64915	.02756
.90	-5.41339	4.64617	1.83177	.72619	.75471	.03485
1.00	-4.95804	4.45954	1.90046	.64576	.85248	.04298
1.10	-4.52169	4.26638	1.96063	.55606	.93970	.05195
1.20	-4.10493	4.06771	2.01142	.45827	1.01411	.06176
1.30	-3.70829	3.86446	2.05208	.35376	1.07393	.07240
1.40	-3.33215	3.65767	2.08201	.24405	1.11784	.08386
1.50	-2.97683	3.44849	2.10077	.13078	1.14497	.09615
1.60	-2.64250	3.23792	2.10811	.01566	1.15493	.10926
1.70	-2.32925	3.02724	2.10390	-.09959	1.14771	.12318
1.80	-2.03702	2.81755	2.08824	-.21329	1.12371	.13791
1.90	-1.76567	2.60999	2.06135	-.32377	1.08367	.15343
2.00	-1.51492	2.40569	2.02363	-.42949	1.02864	.16975
2.10	-1.28440	2.20563	1.97564	-.52901	.95995	.18684
2.20	-1.07363	2.01088	1.91806	-.62105	.87916	.20471
2.30	-.88203	1.82233	1.85170	-.70448	.78799	.22334
2.40	-.70895	1.64081	1.77747	-.77835	.68829	.24271
2.50	-.55363	1.46710	1.69636	-.84190	.58200	.26281
2.60	-.41527	1.30175	1.60943	-.89458	.47109	.28360
2.70	-.29300	1.14536	1.51779	-.93603	.35753	.30506
2.80	-.18590	.99832	1.42258	-.96607	.24326	.32713
2.90	-.09303	.86093	1.32493	-.98472	.13014	.34972
3.00	-.01341	.73339	1.22598	-.99220	.01998	.37256
3.10	.05395	.61574	1.12683	-.98894	-.08362	.38750
3.20	.11004	.50798	1.02850	-.97587	-.17607	.40000
3.30	.15585	.40998	.93193	-.95413	-.25715	.41250
3.40	.19234	.32151	.83791	-.92484	-.32697	.42500
3.50	.22044	.24228	.74716	-.88912	-.38578	.43750
3.60	.24107	.17194	.66026	-.84806	-.43394	.45000
3.70	.25510	.11008	.57768	-.80270	-.47193	.46250
3.80	.26334	.05624	.49982	-.75401	-.50035	.47500
3.90	.26659	.00994	.42695	-.70294	-.51985	.48750
4.00	.26556	-.02940	.35928	-.65034	-.53112	.50000

APPENDIX G

RESULTS FOR PILES WITH A = 2.00

TABLE 20. COEFFICIENTS FOR PILE WITH POSITIVE MOMENT AT GROUND SURFACE

$A = 2.00$ $\qquad$ $K = (\beta x/8.0)K_{8.0}$

βx	C_y	C_S	C_M	C_V	C_q	$K/K_{8.0}$
.00	-7.95558	6.14984	2.00000	1.00000	.00000	.00000
.10	-7.35076	5.94475	2.09936	.98077	.36753	.01250
.20	-6.76694	5.72999	2.19509	.92814	.67669	.02500
.30	-6.20505	5.50597	2.28411	.84738	.93075	.03750
.40	-5.66601	5.27349	2.36386	.74382	1.13320	.05000
.50	-5.15059	5.03362	2.43232	.62244	1.28764	.06250
.60	-4.65948	4.78749	2.48793	.48786	1.39754	.07500
.70	-4.19324	4.53650	2.52961	.34430	1.46763	.08750
.80	-3.75229	4.28208	2.55664	.19562	1.50091	.10000
.90	-3.33688	4.02571	2.56868	.04527	1.50159	.11250
1.00	-2.94776	3.76889	2.56574	-.10367	1.47358	.12500
1.10	-2.58707	3.51308	2.54807	-.24855	1.42069	.13750
1.20	-2.24446	3.25976	2.51622	-.38706	1.34668	.15000
1.30	-1.93100	3.01031	2.47092	-.51727	1.25515	.16250
1.40	-1.64224	2.76602	2.41308	-.63760	1.14956	.17500
1.50	-1.37759	2.52811	2.34375	-.74680	1.03519	.18750
1.60	-1.13638	2.29764	2.26409	-.84394	.90910	.20000
1.70	-.91780	2.07561	2.17535	-.92845	.78013	.21250
1.80	-.72097	1.86285	2.07881	-.99994	.64887	.22500
1.90	-.54492	1.66007	1.97578	-1.05823	.51767	.23750
2.00	-.38862	1.46788	1.86757	-1.10352	.38862	.25000
2.10	-.25100	1.28670	1.75547	-1.13600	.26355	.26250
2.20	-.13092	1.11687	1.64073	-1.15643	.14402	.27500
2.30	-.02726	.95860	1.52455	-1.16514	.03135	.28750
2.40	.06115	.81197	1.40805	-1.16298	-.07378	.30000
2.50	.13549	.67697	1.29227	-1.15077	-.16937	.31250
2.60	.19691	.55346	1.17818	-1.12944	-.25598	.32500
2.70	.24654	.44124	1.06663	-1.09992	-.33283	.33750
2.80	.28550	.34002	.95841	-1.06322	-.39970	.35000
2.90	.31488	.24942	.85418	-1.02034	-.45657	.36250
3.00	.33571	.16902	.75451	-.97226	-.50356	.37500
3.10	.34899	.09834	.65986	-.91996	-.54093	.38750
3.20	.35566	.03685	.57062	-.86440	-.56906	.40000
3.30	.35663	-.01598	.48706	-.80646	-.58844	.41250
3.40	.35272	-.06075	.40937	-.74700	-.59963	.42500
3.50	.34471	-.09806	.33768	-.68680	-.60325	.43750
3.60	.33332	-.12850	.27201	-.62659	-.59999	.45000
3.70	.31921	-.15268	.21234	-.56702	-.59054	.46250
3.80	.30296	-.17118	.15857	-.50868	-.57564	.47500
3.90	.28513	-.18460	.11055	-.45206	-.55641	.48750
4.00	.26619	-.19353	.06809	-.39750	-.53238	.50000

TABLE 21. COEFFICIENTS FOR PILE WITH POSITIVE MOMENT AT GROUND SURFACE

A = 2.00 R = 5.00 T = 2.425

βx	C_y	C_S	C_M	C_V	C_q	$K/K_{8.0}$
.00	-8.98302	6.65386	2.00000	1.00000	-.00000	-.00000
.10	-8.32781	6.44875	2.09993	.99710	.07905	.00237
.20	-7.69359	6.23380	2.19898	.98028	.26907	.00874
.30	-7.08135	6.00905	2.29529	.94138	.51336	.01812
.40	-6.49207	5.77492	2.38646	.87714	.77120	.02969
.50	-5.92664	5.53210	2.46992	.78766	1.01463	.04279
.60	-5.38590	5.28129	2.54327	.67536	1.22570	.05689
.70	-4.87059	5.02382	2.60440	.54403	1.39422	.07156
.80	-4.38131	4.76091	2.65163	.39819	1.51573	.08648
.90	-3.91853	4.49403	2.68373	.24256	1.58991	.10143
1.00	-3.48258	4.22477	2.69998	.08179	1.61928	.11624
1.10	-3.07361	3.95461	2.70006	-.07986	1.60816	.13089
1.20	-2.69163	3.68528	2.68410	-.23859	1.56185	.14506
1.30	-2.33648	3.41834	2.65254	-.39119	1.48608	.15900
1.40	-2.00784	3.15530	2.60614	-.53497	1.38653	.17263
1.50	-1.70525	2.89764	2.54589	-.66784	1.26861	.18598
1.60	-1.42811	2.64657	2.47296	-.78822	1.13728	.19908
1.70	-1.17569	2.40342	2.38867	-.89498	.99695	.21199
1.80	-.94715	2.16919	2.29441	-.98743	.85146	.22474
1.90	-.74154	1.94484	2.19164	-1.06521	.70413	.23738
2.00	-.55785	1.73114	2.08183	-1.12829	.55775	.24995
2.10	-.39496	1.52867	1.96644	-1.17688	.41470	.26248
2.20	-.52174	1.33798	1.84689	-1.21141	.57392	.27499
2.30	-.12699	1.15939	1.72458	-1.23251	.14604	.28749
2.40	-.01948	.99311	1.60079	-1.24091	.02338	.30000
2.50	.07201	.83925	1.47676	-1.23751	-.09001	.31250
2.60	.14874	.69773	1.35363	-1.22327	-.19337	.32500
2.70	.21194	.56845	1.23242	-1.19921	-.28612	.33750
2.80	.26281	.45115	1.11406	-1.16643	-.36793	.35000
2.90	.30253	.34550	.99937	-1.12602	-.43868	.36250
3.00	.33226	.25112	.88906	-1.07908	-.49840	.37500
3.10	.35310	.16752	.78372	-1.02672	-.54730	.38750
3.20	.36609	.09418	.68385	-.96999	-.58575	.40000
3.30	.37224	.03054	.58983	-.90992	-.61420	.41250
3.40	.37249	-.02400	.50194	-.84749	-.63323	.42500
3.50	.36771	-.07007	.42038	-.78359	-.64350	.43750
3.60	.35872	-.10831	.34524	-.71907	-.64571	.45000
3.70	.34628	-.13935	.27656	-.65470	-.64062	.46250
3.80	.33106	-.16384	.21428	-.59118	-.62902	.47500
3.90	.31370	-.18243	.15828	-.52910	-.61172	.48750
4.00	.29475	-.19576	.10839	-.46898	-.58950	.50000

TABLE 22. COEFFICIENTS FOR PILE WITH POSITIVE MOMENT AT GROUND SURFACE

A = 2.00 R = 2.75 T = 2.525

βy	C_y	C_S	C_M	C_V	C_q	$K/K_{8.0}$
.00	-10.02660	7.10668	2.00000	1.00000	-.00000	-.00000
.10	-9.32609	6.90157	2.09996	.99822	.04904	.00131
.20	-8.64659	6.68660	2.19936	.98745	.17554	.00507
.30	-7.98908	6.46176	2.29696	.96135	.35205	.01101
.40	-7.35454	6.22733	2.39103	.91609	.55552	.01888
.50	-6.74390	5.98382	2.47953	.84996	.76700	.02843
.60	-6.15805	5.73170	2.56036	.76294	.97136	.03943
.70	-5.59780	5.47203	2.63150	.65636	1.15692	.05166
.80	-5.06385	5.20581	2.69110	.53253	1.31515	.06492
.90	-4.55680	4.93427	2.73757	.39450	1.44032	.07902
1.00	-4.07712	4.65886	2.76966	.24576	1.52911	.09376
1.10	-3.62512	4.38088	2.78650	.09001	1.58033	.10898
1.20	-3.20097	4.10207	2.78756	-.06900	1.59451	.12453
1.30	-2.80468	3.82394	2.77271	-.22765	1.57361	.14026
1.40	-2.43611	3.54808	2.74215	-.38259	1.52067	.15605
1.50	-2.09494	3.27608	2.69640	-.53079	1.43953	.17178
1.60	-1.78073	3.00931	2.63628	-.66965	1.33456	.18736
1.70	-1.49287	2.74926	2.56283	-.79702	1.21040	.20269
1.80	-1.23063	2.49717	2.47729	-.91122	1.07175	.21772
1.90	-.99315	2.25418	2.38104	-1.01102	.92321	.23239
2.00	-.77947	2.02132	2.27556	-1.09566	.76910	.24667
2.10	-.58855	1.79935	2.16239	-1.16478	.61338	.26054
2.20	-.41924	1.58903	2.04309	-1.21840	.45952	.27402
2.30	-.27036	1.39089	1.91919	-1.25686	.31051	.28712
2.40	-.14067	1.20531	1.79217	-1.28076	.16876	.29992
2.50	-.02890	1.03253	1.66347	-1.29094	.03612	.31249
2.60	.06623	.87263	1.53439	-1.28836	-.08610	.32500
2.70	.14602	.72561	1.40616	-1.27411	-.19713	.33750
2.80	.21175	.59133	1.27989	-1.24935	-.29645	.35000
2.90	.26468	.46953	1.15658	-1.21525	-.38378	.36250
3.00	.30603	.35988	1.03710	-1.17302	-.45905	.37500
3.10	.33702	.26195	.92219	-1.12386	-.52238	.38750
3.20	.35878	.17525	.81250	-1.06895	-.57405	.40000
3.30	.37241	.09924	.70855	-1.00945	-.61448	.41250
3.40	.37895	.03333	.61072	-.94644	-.64421	.42500
3.50	.37937	-.02313	.51934	-.88096	-.66391	.43750
3.60	.37460	-.07078	.43458	-.81398	-.67429	.45000
3.70	.36548	-.11028	.35656	-.74640	-.67614	.46250
3.80	.35278	-.14233	.28529	-.67903	-.67029	.47500
3.90	.33723	-.16758	.22072	-.61259	-.65760	.48750
4.00	.31946	-.18676	.16273	-.54770	-.63893	.50000

TABLE 23. COEFFICIENTS FOR PILE WITH POSITIVE MOMENT AT GROUND SURFACE

A = 2.00 B = 1.80 T = 2.650

βx	C_y	C_S	C_M	C_V	C_q	$K/K_{B.0}$
.00	-11.19181	7.57603	2.00000	1.00000	-.00000	-.00000
.10	-10.44438	7.37092	2.09997	.99874	.03493	.00083
.20	-9.71794	7.15594	2.19954	.99096	.12801	.00329
.30	-9.01350	6.93105	2.29780	.97166	.26293	.00729
.40	-8.33204	6.69647	2.39340	.93740	.42513	.01275
.50	-7.67450	6.45259	2.48475	.88612	.60177	.01960
.60	-7.04180	6.19973	2.57007	.81693	.78172	.02775
.70	-6.43481	5.93879	2.64758	.73000	.95553	.03712
.80	-5.85427	5.67056	2.71554	.62632	1.11540	.04763
.90	-5.30089	5.39608	2.77237	.50763	1.25511	.05919
1.00	-4.77521	5.11658	2.81667	.37418	1.36997	.07172
1.10	-4.27770	4.83323	2.84729	.23463	1.45669	.08513
1.20	-3.80864	4.54759	2.86337	.08591	1.51332	.09933
1.30	-3.36821	4.26109	2.86434	-.06694	1.53910	.11423
1.40	-2.95640	3.97526	2.84995	-.22083	1.53435	.12974
1.50	-2.57308	3.69169	2.82024	-.37277	1.50034	.14577
1.60	-2.21795	3.41175	2.77555	-.51994	1.43913	.16221
1.70	-1.89057	3.13705	2.71648	-.65973	1.35343	.17897
1.80	-1.59034	2.86893	2.64390	-.78987	1.24644	.19594
1.90	-1.31654	2.60871	2.55887	-.90839	1.12176	.21301
2.00	-1.06831	2.35758	2.46264	-1.01373	.98318	.23007
2.10	-.84471	2.11653	2.35658	-1.10468	.83462	.24701
2.20	-.64466	1.88654	2.24218	-1.18044	.67997	.26369
2.30	-.46703	1.66834	2.12098	-1.24059	.52304	.27998
2.40	-.31061	1.46253	1.99455	-1.28509	.36741	.29571
2.50	-.17412	1.26957	1.86444	-1.31424	.21641	.31072
2.60	-.05628	1.08972	1.73216	-1.32865	.07311	.32474
2.70	.04423	.92315	1.59914	-1.32923	-.05971	.33750
2.80	.12875	.76987	1.46671	-1.31714	-.18026	.35000
2.90	.19861	.62975	1.33607	-1.29363	-.28799	.36250
3.00	.25511	.50256	1.20830	-1.26000	-.38267	.37500
3.10	.29952	.38795	1.08435	-1.21756	-.46426	.38750
3.20	.33308	.28552	.96502	-1.16761	-.53294	.40000
3.30	.35699	.19476	.85102	-1.11142	-.58904	.41250
3.40	.37239	.11511	.74290	-1.05023	-.63306	.42500
3.50	.38035	.04596	.64109	-.98521	-.66561	.43750
3.60	.38189	-.01335	.54594	-.91749	-.68740	.45000
3.70	.37797	-.06347	.45765	-.84808	-.69924	.46250
3.80	.36946	-.10512	.37634	-.77796	-.70198	.47500
3.90	.35719	-.13899	.30205	-.70798	-.69652	.48750
4.00	.34189	-.16585	.23472	-.63889	-.68379	.50000

TABLE 24. COEFFICIENTS FOR PILE WITH POSITIVE MOMENT AT GROUND SURFACE

A = 2.00   R = 1.35   T = 2.775

βx	C_y	C_S	C_M	C_V	C_q	$K/K_{8.0}$
.00	-12.26338	7.98355	2.00000	1.00000	-.00000	-.00000
.10	-11.47519	7.77844	2.09998	.99900	.02773	.00060
.20	-10.70800	7.56345	2.19964	.99278	.10285	.00240
.30	-9.96281	7.33855	2.29824	.97716	.21387	.00536
.40	-9.24059	7.10388	2.39468	.94910	.35026	.00947
.50	-8.54232	6.85981	2.48760	.90655	.50239	.01470
.60	-7.86893	6.60654	2.57550	.84837	.66164	.02102
.70	-7.22128	6.34487	2.65678	.77424	.82037	.02840
.80	-6.60019	6.07548	2.72986	.68455	.97195	.03681
.90	-6.00640	5.79925	2.79323	.58030	1.11076	.04623
1.00	-5.44052	5.51729	2.84551	.46301	1.23219	.05662
1.10	-4.90309	5.23058	2.88549	.33461	1.33259	.06794
1.20	-4.39451	4.94060	2.91216	.19734	1.40930	.08017
1.30	-3.91503	4.64865	2.92475	.05365	1.46056	.09326
1.40	-3.46480	4.35617	2.92277	-.09384	1.48546	.10718
1.50	-3.04377	4.06467	2.90595	-.24250	1.48390	.12188
1.60	-2.65179	3.77550	2.87431	-.38971	1.45650	.13731
1.70	-2.28855	3.49028	2.82813	-.53293	1.40454	.15343
1.80	-1.95357	3.21038	2.76792	-.66981	1.32984	.17018
1.90	-1.64626	2.93716	2.69444	-.79818	1.23470	.18750
2.00	-1.36589	2.67196	2.60861	-.91612	1.12178	.20532
2.10	-1.11159	2.41584	2.51159	-1.02201	.99407	.22357
2.20	-.88240	2.16996	2.40463	-1.11452	.85471	.24215
2.30	-.67725	1.93522	2.28913	-1.19264	.70696	.26096
2.40	-.49498	1.71239	2.16657	-1.25574	.55414	.27987
2.50	-.33438	1.50212	2.03847	-1.30342	.39953	.29871
2.60	-.19415	1.30484	1.90637	-1.33569	.24635	.31720
2.70	-.07299	1.12091	1.77180	-1.35285	.09779	.33492
2.80	.03044	.95051	1.63625	-1.35554	-.04262	.35000
2.90	.11753	.79365	1.50112	-1.34478	-.17042	.36250
3.00	.18960	.65024	1.36767	-1.32194	-.28440	.37500
3.10	.24799	.52002	1.23706	-1.28840	-.38439	.38750
3.20	.29401	.40268	1.11028	-1.24556	-.47041	.40000
3.30	.32892	.29779	.98820	-1.19480	-.54272	.41250
3.40	.35394	.20485	.87153	-1.13749	-.60171	.42500
3.50	.37025	.12328	.76086	-1.07491	-.64794	.43750
3.60	.37894	.05245	.65667	-1.00833	-.68209	.45000
3.70	.38106	-.00830	.55929	-.93889	-.70496	.46250
3.80	.37758	-.05966	.46895	-.86770	-.71740	.47500
3.90	.36940	-.10234	.38577	-.79575	-.72034	.48750
4.00	.35736	-.13714	.30979	-.72393	-.71473	.50000

TABLE 25. COEFFICIENTS FOR PILE WITH POSITIVE MOMENT AT GROUND SURFACE

A = 2.00 R = 1.05 T = 2.900

βx	C_y	C_S	C_M	C_V	C_q	$K/K_{8.0}$
.00	-13.40458	8.39806	2.00000	1.00000	-.00000	-.00000
.10	-12.57494	8.19295	2.09998	.99918	.02274	.00045
.20	-11.76630	7.97796	2.19970	.99405	.08505	.00180
.30	-10.97966	7.75304	2.29854	.98107	.17841	.00406
.40	-10.21600	7.51832	2.39558	.95755	.29484	.00721
.50	-9.47629	7.27410	2.48966	.92155	.42692	.01126
.60	-8.76148	7.02053	2.57947	.87185	.56783	.01620
.70	-8.07245	6.75834	2.66359	.80789	.71138	.02203
.80	-7.41006	6.48807	2.74060	.72968	.85202	.02874
.90	-6.77507	6.21052	2.80909	.63776	.98487	.03634
1.00	-6.16815	5.92666	2.86775	.53313	1.10574	.04481
1.10	-5.58991	5.63736	2.91536	.41716	1.21113	.05416
1.20	-5.04081	5.34396	2.95088	.29155	1.29823	.06438
1.30	-4.52121	5.04765	2.97343	.15824	1.36489	.07547
1.40	-4.03133	4.74976	2.98235	.01935	1.40964	.08741
1.50	-3.57126	4.45172	2.97720	-.12288	1.43164	.10021
1.60	-3.14095	4.15482	2.95775	-.26616	1.43064	.11387
1.70	-2.74021	3.86063	2.92400	-.40821	1.40698	.12836
1.80	-2.36870	3.57052	2.87621	-.54679	1.36146	.14369
1.90	-2.02594	3.28587	2.81482	-.67977	1.29538	.15984
2.00	-1.71131	3.00805	2.74050	-.80519	1.21039	.17682
2.10	-1.42408	2.73820	2.65408	-.92128	1.10852	.19460
2.20	-1.16338	2.47759	2.55659	-1.02638	.99201	.21317
2.30	-.92824	2.22724	2.44919	-1.11923	.86335	.23252
2.40	-.71758	1.98806	2.33316	-1.19874	.72513	.25262
2.50	-.53025	1.76089	2.20989	-1.26404	.58001	.27346
2.60	-.36502	1.54629	2.08082	-1.31457	.43070	.29498
2.70	-.22058	1.34485	1.94745	-1.35009	.27982	.31713
2.80	-.09562	1.15690	1.81127	-1.37057	.12997	.33980
2.90	.01122	.98265	1.67380	-1.37622	-.01627	.36250
3.00	.10133	.82215	1.53647	-1.36769	-.15200	.37500
3.10	.17608	.67530	1.40066	-1.34634	-.27292	.38750
3.20	.23682	.54191	1.26756	-1.31364	-.37891	.40000
3.30	.28487	.42165	1.13824	-1.27108	-.47005	.41250
3.40	.32155	.31410	1.01361	-1.22014	-.54663	.42500
3.50	.34808	.21874	.89443	-1.16226	-.60914	.43750
3.60	.36566	.13500	.78133	-1.09879	-.65820	.45000
3.70	.37543	.06224	.67480	-1.03107	-.69454	.46250
3.80	.37844	-.00021	.57521	-.96030	-.71903	.47500
3.90	.37569	-.05305	.48280	-.88765	-.73259	.48750
4.00	.36811	-.09711	.39771	-.81413	-.73622	.50000

APPENDIX H

RESULTS FOR PILES WITH A = 4.00

TABLE 26. COEFFICIENTS FOR PILE WITH POSITIVE MOMENT AT GROUND SURFACE

A = 4.00 $\qquad$ $K = (\beta X/8.0)K_{8.0}$

βx	C_y	C_S	C_M	C_V	C_q	$K/K_{8.0}$
.00	-12.22920	10.16287	4.00000	1.00000	.00000	.00000
.10	-11.23308	9.75779	4.09902	.97056	.56165	.01250
.20	-10.27794	9.34315	4.19250	.89041	1.02779	.02500
.30	-9.36472	8.91965	4.27579	.76816	1.40470	.03750
.40	-8.49425	8.48849	4.34509	.61240	1.69865	.05000
.50	-7.66721	8.05127	4.39747	.43109	1.91680	.06250
.60	-6.88414	7.60968	4.43074	.23150	2.06524	.07500
.70	-6.14535	7.16581	4.44341	.02026	2.15087	.08750
.80	-5.45098	6.72175	4.43461	-.19668	2.18039	.10000
.90	-4.80094	6.27966	4.40406	-.41405	2.16042	.11250
1.00	-4.19491	5.84173	4.35193	-.62724	2.09745	.12500
1.10	-3.63240	5.41002	4.27887	-.83225	1.99782	.13750
1.20	-3.11265	4.98664	4.18585	-1.02572	1.86759	.15000
1.30	-2.63475	4.57351	4.07417	-1.20489	1.71258	.16250
1.40	-2.19757	4.17241	3.94538	-1.36755	1.53830	.17500
1.50	-1.79983	3.78500	3.80123	-1.51205	1.34987	.18750
1.60	-1.44010	3.41265	3.64358	-1.63720	1.15208	.20000
1.70	-1.11679	3.05667	3.47441	-1.74226	.94927	.21250
1.80	-.82822	2.71810	3.29576	-1.82702	.74540	.22500
1.90	-.57260	2.39778	3.10964	-1.89146	.54397	.23750
2.00	-.34807	2.09638	2.91809	-1.93601	.34807	.25000
2.10	-.15272	1.81429	2.72304	-1.96136	.16035	.26250
2.20	.01540	1.55182	2.52638	-1.96845	-.01694	.27500
2.30	.15825	1.30901	2.32989	-1.95841	-.18199	.28750
2.40	.27781	1.08578	2.13520	-1.93253	-.33338	.30000
2.50	.37602	.88186	1.94383	-1.89225	-.47002	.31250
2.60	.45478	.69684	1.75715	-1.83908	-.59121	.32500
2.70	.51596	.53022	1.57637	-1.77457	-.69655	.33750
2.80	.56138	.38132	1.40254	-1.70033	-.78593	.35000
2.90	.59276	.24943	1.23656	-1.61794	-.85951	.36250
3.00	.61177	.13371	1.07916	-1.52897	-.91766	.37500
3.10	.61999	.03328	.93092	-1.43494	-.96098	.38750
3.20	.61888	-.05280	.79228	-1.33728	-.99021	.40000
3.30	.60984	-.12552	.66353	-1.23736	-1.00625	.41250
3.40	.59416	-.18586	.54484	-1.13646	-1.01008	.42500
3.50	.57393	-.23484	.43623	-1.03574	-1.00280	.43750
3.60	.54752	-.27347	.33765	-.93625	-.98554	.45000
3.70	.51863	-.30272	.24892	-.83894	-.95947	.46250
3.80	.48724	-.32359	.16977	-.74463	-.92576	.47500
3.90	.45414	-.33700	.09987	-.65402	-.88559	.48750
4.00	.42004	-.34394	.03883	-.56765	-.840 9	.50000

TABLE 27. COEFFICIENTS FOR PILE WITH POSITIVE MOMENT AT GROUND SURFACE

A = 4.00 B = 5.00 T = 2.275

βx	C_y	C_S	C_M	C_V	C_Q	$K/K_{8.0}$
.00	-13.63301	10.85814	4.00000	1.00000	-.00000	-.00000
.10	-12.56736	10.45304	4.09989	.99534	.12648	.00251
.20	-11.54271	10.03811	4.19837	.96862	.42566	.00921
.30	-10.56004	9.61352	4.29253	.90748	.80294	.01900
.40	-9.62029	9.17989	4.37865	.80762	1.19238	.03098
.50	-8.72431	8.73823	4.45287	.67013	1.55047	.04442
.60	-7.87285	8.28986	4.51164	.49958	1.85085	.05877
.70	-7.06650	7.83654	4.55195	.30249	2.07993	.07358
.80	-6.30564	7.38021	4.57154	.08628	2.23329	.08854
.90	-5.59048	6.92302	4.56885	-.14158	2.31282	.10342
1.00	-4.92099	6.46727	4.54309	-.37388	2.32445	.11808
1.10	-4.29691	6.01523	4.49413	-.60432	2.27644	.13244
1.20	-3.71776	5.56923	4.42246	-.82738	2.17810	.14646
1.30	-3.18281	5.13151	4.32903	-1.03850	2.03891	.16015
1.40	-2.69113	4.70415	4.21524	-1.23404	1.86794	.17352
1.50	-2.24159	4.28913	4.08280	-1.41126	1.67348	.18663
1.60	-1.83287	3.88818	3.93363	-1.56817	1.46292	.19954
1.70	-1.46346	3.50291	3.76984	-1.70350	1.24266	.21228
1.80	-1.13175	3.13466	3.59363	-1.81658	1.01817	.22491
1.90	-.83597	2.78455	3.40723	-1.90715	.79407	.23747
2.00	-.57425	2.45350	3.21289	-1.97552	.57423	.24999
2.10	-.34465	2.14217	3.01280	-2.02226	.36188	.26249
2.20	-.14518	1.85106	2.80909	-2.04826	.15970	.27500
2.30	.02620	1.58041	2.60377	-2.05464	-.03013	.28750
2.40	.17154	1.33030	2.39873	-2.04273	-.20585	.30000
2.50	.29290	1.10060	2.19575	-2.01401	-.36612	.31250
2.60	.39229	.89102	1.99641	-1.97009	-.50998	.32500
2.70	.47172	.70114	1.80215	-1.91262	-.63683	.33750
2.80	.53312	.53037	1.61425	-1.84333	-.74637	.35000
2.90	.57838	.37802	1.43380	-1.76396	-.83865	.36250
3.00	.60928	.24332	1.26172	-1.67621	-.91393	.37500
3.10	.62757	.12536	1.09877	-1.58175	-.97273	.38750
3.20	.63485	.02322	.94553	-1.48222	-1.01577	.40000
3.30	.63268	-.06410	.80244	-1.37913	-1.04392	.41250
3.40	.62247	-.13763	.66977	-1.27392	-1.05820	.42500
3.50	.60555	-.19842	.54768	-1.16794	-1.05972	.43750
3.60	.58315	-.24754	.43617	-1.06239	-1.04968	.45000
3.70	.55638	-.28603	.33515	-.95837	-1.02931	.46250
3.80	.52625	-.31493	.24442	-.85685	-.99988	.47500
3.90	.49367	-.33526	.16368	-.75867	-.96266	.48750
4.00	.45944	-.34807	.09256	-.66450	-.91889	.50000

TABLE 28. COEFFICIENTS FOR PILE WITH POSITIVE MOMENT AT GROUND SURFACE

A = 4.00 R = 2.75 T = 2.400

βx	C_y	C_S	C_M	C_V	C_q	$K/K_{8.0}$
.00	-15.10580	11.50637	4.00000	1.00000	-.00010	-.00000
.10	-13.97533	11.10126	4.09993	.99720	.07717	.00138
.20	-12.88586	10.68631	4.19899	.98033	.27421	.00532
.30	-11.83838	10.26156	4.29525	.93972	.54575	.01152
.40	-10.83384	9.82745	4.38602	.86987	.85437	.01971
.50	-9.87316	9.38469	4.46824	.76861	1.16995	.02962
.60	-8.95715	8.93422	4.53877	.63647	1.46897	.04099
.70	-8.08651	8.47743	4.59465	.47603	1.73384	.05360
.80	-7.26181	8.01590	4.63322	.29138	1.95224	.06720
.90	-6.48342	7.55148	4.65232	.08750	2.11644	.08160
1.00	-5.75154	7.08621	4.65030	-.12988	2.22260	.09660
1.10	-5.06614	6.62220	4.62610	-.35494	2.27019	.11202
1.20	-4.42699	6.16177	4.57925	-.58192	2.26135	.12770
1.30	-3.83361	5.70715	4.50983	-.80536	2.20025	.14348
1.40	-3.28531	5.26058	4.41844	-1.02032	2.09265	.15924
1.50	-2.78117	4.82422	4.30617	-1.22248	1.94531	.17486
1.60	-2.32008	4.40004	4.17446	-1.40824	1.76559	.19025
1.70	-1.90072	3.98994	4.02512	-1.57472	1.56107	.20532
1.80	-1.52160	3.59557	3.86019	-1.71984	1.33918	.22002
1.90	-1.18107	3.21838	3.68187	-1.84220	1.10700	.23432
2.00	-.87735	2.85960	3.49248	-1.94110	.87099	.24818
2.10	-.60855	2.52019	3.29438	-2.01646	.63688	.26163
2.20	-.37268	2.20094	3.08991	-2.06872	.40951	.27470
2.30	-.16771	1.90235	2.88134	-2.09875	.19284	.28745
2.40	.00844	1.62474	2.67082	-2.10777	-.01013	.30000
2.50	.15789	1.36819	2.46039	-2.09728	-.19736	.31250
2.60	.28274	1.13259	2.25192	-2.06890	-.36756	.32500
2.70	.38506	.91768	2.04712	-2.02440	-.51983	.33750
2.80	.46691	.72299	1.84749	-1.96559	-.65367	.35000
2.90	.53028	.54795	1.65439	-1.89432	-.76890	.36250
3.00	.57709	.39185	1.46896	-1.81246	-.86564	.37500
3.10	.60921	.25386	1.29217	-1.72184	-.94428	.38750
3.20	.62841	.13308	1.12481	-1.62423	-1.00545	.40000
3.30	.63634	.02854	.96749	-1.52134	-1.04997	.41250
3.40	.63459	-.06078	.82066	-1.41479	-1.07881	.42500
3.50	.62463	-.13596	.68460	-1.30609	-1.09311	.43750
3.60	.60781	-.19808	.55946	-1.19664	-1.09407	.45000
3.70	.58539	-.24824	.44526	-1.08770	-1.08298	.46250
3.80	.55851	-.28751	.34187	-.98042	-1.06117	.47500
3.90	.52820	-.31698	.24909	-.87580	-1.02999	.48750
4.00	.49539	-.33777	.16660	-.77466	-.99078	.50000

TABLE 29. COEFFICIENTS FOR PILE WITH POSITIVE MOMENT AT GROUND SURFACE

A = 4.00 B = 1.80 T = 2.525

βx	C_y	C_S	C_M	C_V	C_q	$K/K_{8.0}$
.00	-16.72427	12.16892	4.00000	1.00000	-.00000	-.00000
.10	-15.52755	11.76381	4.09995	.99803	.05446	.00087
.20	-14.37182	11.34884	4.19929	.98594	.19837	.00345
.30	-13.25809	10.92403	4.29658	.95614	.40493	.00763
.40	-12.18731	10.48967	4.38980	.90358	.65050	.01334
.50	-11.16043	10.04633	4.47650	.82539	.91461	.02048
.60	-10.17831	9.59470	4.55404	.72062	1.17978	.02897
.70	-9.24172	9.13591	4.61981	.58091	1.43148	.03872
.80	-8.35131	8.67124	4.67128	.43820	1.65798	.04963
.90	-7.50760	8.20224	4.70619	.25953	1.85022	.06161
1.00	-6.71094	7.73068	4.72264	.06662	2.00162	.07456
1.10	-5.96149	7.25842	4.71911	-.13920	2.10793	.08839
1.20	-5.25921	6.78758	4.69454	-.35329	2.16609	.10300
1.30	-4.60387	6.32028	4.64834	-.57091	2.17854	.11829
1.40	-3.99498	5.85868	4.58040	-.78737	2.14393	.13416
1.50	-3.43188	5.40497	4.49105	-.99816	2.06595	.15049
1.60	-2.91368	4.96121	4.38107	-1.19916	1.94854	.16718
1.70	-2.43927	4.52943	4.25164	-1.38665	1.79654	.18412
1.80	-2.00736	4.11151	4.10427	-1.55744	1.61546	.20119
1.90	-1.61648	3.70915	3.94076	-1.70892	1.41126	.21826
2.00	-1.26499	3.32387	3.76315	-1.83909	1.19012	.23520
2.10	-.95113	2.95694	3.57365	-1.94657	.95828	.25187
2.20	-.67299	2.60947	3.37457	-2.03058	.72151	.26813
2.30	-.42859	2.28229	3.16827	-2.09097	.48654	.28379
2.40	-.21588	1.97599	2.95710	-2.12813	.25759	.29865
2.50	-.03273	1.69097	2.74335	-2.14296	.04090	.31242
2.60	.12298	1.42734	2.52917	-2.13688	-.15987	.32500
2.70	.25340	1.18507	2.31657	-2.11165	-.34209	.33750
2.80	.36066	.96391	2.10738	-2.06915	-.50492	.35000
2.90	.44683	.76342	1.90322	-2.01136	-.64791	.36250
3.00	.51397	.58304	1.70552	-1.94027	-.77096	.37500
3.10	.56405	.42205	1.51552	-1.85787	-.87429	.38750
3.20	.59897	.27963	1.33424	-1.76610	-.95835	.40000
3.30	.62053	.15487	1.16253	-1.66685	-1.02359	.41250
3.40	.63047	.04677	1.00104	-1.56195	-1.07150	.42500
3.50	.63038	-.04571	.85026	-1.45308	-1.10317	.43750
3.60	.62178	-.12367	.71050	-1.34185	-1.11921	.45000
3.70	.60607	-.18821	.58192	-1.22973	-1.12123	.46250
3.80	.58453	-.24045	.46454	-1.11806	-1.11061	.47500
3.90	.55833	-.28150	.35826	-1.00801	-1.08876	.48750
4.00	.52855	-.31257	.26286	-.90061	-1.05710	.50000

TABLE 30. COEFFICIENTS FOR PILE WITH POSITIVE MOMENT AT GROUND SURFACE

A = 4.00 R = 1.35 T = 2.625

βx	C_y	C_S	C_M	C_V	C_q	$K/K_{8.0}$
.00	-18.15114	12.72239	4.00000	1.00000	-.00000	-.00000
.10	-16.89907	12.31729	4.09996	.99845	.04316	.00063
.20	-15.68800	11.90231	4.19943	.98879	.15917	.00253
.30	-14.51892	11.47746	4.29727	.96470	.32911	.00566
.40	-13.39281	11.04297	4.39178	.92167	.53580	.01000
.50	-12.31061	10.59932	4.48092	.85679	.76383	.01551
.60	-11.27321	10.14706	4.56241	.76863	.99954	.02216
.70	-10.28143	9.68716	4.63391	.65703	1.23106	.02993
.80	-9.33598	9.22072	4.69311	.52292	1.44826	.03878
.90	-8.43745	8.74906	4.73785	.36818	1.64276	.04867
1.00	-7.58629	8.27375	4.76618	.19542	1.80784	.05957
1.10	-6.78277	7.79646	4.77646	.00784	1.93843	.07144
1.20	-6.02700	7.31912	4.76740	-.19092	2.03102	.08424
1.30	-5.31888	6.84370	4.73805	-.39695	2.08354	.09793
1.40	-4.65813	6.37225	4.68791	-.60619	2.09531	.11245
1.50	-4.04424	5.90688	4.61684	-.81458	2.06684	.12774
1.60	-3.47650	5.44961	4.52514	-1.01819	1.99978	.14380
1.70	-2.95400	5.00254	4.41347	-1.21327	1.89672	.16052
1.80	-2.47562	4.56759	4.28286	-1.39638	1.76106	.17784
1.90	-2.04005	4.14659	4.13467	-1.56447	1.59685	.19568
2.00	-1.64581	3.74123	3.97052	-1.71490	1.40867	.21397
2.10	-1.29127	3.35299	3.79231	-1.84553	1.20145	.23261
2.20	-.97463	2.98319	3.60209	-1.95470	.98032	.25145
2.30	-.69401	2.63292	3.40207	-2.04128	.75055	.27036
2.40	-.44741	2.30304	3.19456	-2.10469	.51741	.28911
2.50	-.23274	1.99420	2.98186	-2.14483	.28616	.30737
2.60	-.04789	1.70677	2.76630	-2.16218	.06215	.32439
2.70	.10928	1.44096	2.55011	-2.15777	-.14753	.33750
2.80	.24097	1.19671	2.33537	-2.13338	-.33735	.35000
2.90	.34929	.97377	2.12400	-2.09103	-.50648	.36250
3.00	.43638	.77173	1.91766	-2.03282	-.65457	.37500
3.10	.50428	.59001	1.71786	-1.96086	-.78164	.38750
3.20	.55500	.42789	1.52586	-1.87723	-.88810	.40000
3.30	.59045	.28453	1.34272	-1.78397	-.97424	.41250
3.40	.61246	.15900	1.16930	-1.68307	-1.04119	.42500
3.50	.62278	.05030	1.00628	-1.57638	-1.08987	.43750
3.60	.62302	-.04264	.85415	-1.46570	-1.12144	.45000
3.70	.61471	-.12092	.71322	-1.35265	-1.13723	.46250
3.80	.59926	-.18568	.58365	-1.23874	-1.13861	.47500
3.90	.57797	-.23805	.46545	-1.12539	-1.12705	.48750
4.00	.55201	-.27927	.35851	-1.01373	-1.10403	.50000

TABLE 31. COEFFICIENTS FOR PILE WITH POSITIVE MOMENT AT GROUND SURFACE

A = 4.00 R = 1.05 T = 2.750

βx	C_y	C_S	C_M	C_V	C_q	$K/K_{B.O}$
.00	-19.71928	13.30376	4.00000	1.00000	-.00000	-.00000
.10	-18.40907	12.89865	4.09997	.99874	.03511	.00047
.20	-17.13986	12.48367	4.19954	.99084	.13064	.00190
.30	-15.91265	12.05879	4.29776	.97097	.27263	.00428
.40	-14.72841	11.62422	4.39323	.93512	.44816	.00760
.50	-13.58809	11.18034	4.48420	.88056	.64538	.01187
.60	-12.49262	10.72761	4.56871	.80566	.85353	.01708
.70	-11.44282	10.26687	4.64468	.70981	1.06298	.02322
.80	-10.43947	9.79905	4.71002	.59332	1.26523	.03029
.90	-9.48320	9.32531	4.76273	.45728	1.45295	.03830
1.00	-8.57454	8.84704	4.80092	.30346	1.61997	.04723
1.10	-7.71389	8.36570	4.82294	.13420	1.76125	.05708
1.20	-6.90144	7.88306	4.82736	-.04774	1.87288	.06784
1.30	-6.13726	7.40089	4.81309	-.23923	1.95266	.07951
1.40	-5.42119	6.92113	4.77932	-.43694	1.99702	.09209
1.50	-4.75290	6.44575	4.72562	-.63739	2.00700	.10556
1.60	-4.13184	5.97672	4.65187	-.83710	1.98214	.11993
1.70	-3.55729	5.51606	4.55833	-1.03262	1.92345	.13517
1.80	-3.02831	5.06573	4.44558	-1.22066	1.83268	.15129
1.90	-2.54376	4.62760	4.31453	-1.39811	1.71222	.16827
2.00	-2.10235	4.20344	4.16638	-1.56215	1.56504	.18610
2.10	-1.70259	3.79488	4.00260	-1.71029	1.39457	.20477
2.20	-1.34284	3.40341	3.82488	-1.84037	1.20454	.22425
2.30	-1.02133	3.03033	3.63514	-1.95065	.99896	.24452
2.40	-.73616	2.67674	3.43542	-2.03976	.78197	.26555
2.50	-.48534	2.34353	3.22788	-2.10679	.55775	.28730
2.60	-.26679	2.03136	3.01477	-2.15121	.33048	.30967
2.70	-.07839	1.74069	2.79835	-2.17292	.10426	.33247
2.80	.08202	1.47173	2.58088	-2.17229	-.11482	.35000
2.90	.21662	1.22448	2.36455	-2.15068	-.31411	.36250
3.00	.32759	.99872	2.15134	-2.11024	-.49138	.37500
3.10	.41703	.79404	1.94302	-2.05319	-.64640	.38750
3.20	.48704	.60989	1.74115	-1.98175	-.77927	.40000
3.30	.53963	.44554	1.54705	-1.89814	-.89039	.41250
3.40	.57674	.30016	1.36184	-1.80442	-.98047	.42500
3.50	.60023	.17283	1.18642	-1.70273	-1.05041	.43750
3.60	.61185	.06251	1.02148	-1.59501	-1.10133	.45000
3.70	.61324	-.03185	.86755	-1.48309	-1.13449	.46250
3.80	.60594	-.11139	.72494	-1.36869	-1.15129	.47500
3.90	.59139	-.17725	.59384	-1.25336	-1.15321	.48750
4.00	.57089	-.23068	.47425	-1.13850	-1.14178	.50000

TABLE 32. COEFFICIENTS FOR PILE WITH POSITIVE MOMENT AT GROUND SURFACE

A = 4.00 B = 1.05 U = 3.50 T = 2.850

βx	C_y	C_S	C_M	C_V	C_q	$K/K_{8.0}$
.00	-21.78514	14.12564	4.00000	1.00000	-.00000	-.00000
.10	-20.39274	13.72054	4.10000	.99987	.00441	.00005
.20	-19.04134	13.30554	4.19993	.99831	.03148	.00041
.30	-17.73194	12.88056	4.29952	.99230	.09453	.00133
.40	-16.46554	12.44567	4.39813	.97794	.19871	.00301
.50	-15.24311	12.00104	4.49472	.95113	.34301	.00562
.60	-14.06563	11.54685	4.58785	.90810	.52199	.00927
.70	-12.93403	11.08362	4.67573	.84580	.72723	.01405
.80	-11.84917	10.61196	4.75634	.76208	.94862	.02001
.90	-10.81187	10.13269	4.82745	.65588	1.17534	.02717
1.00	-9.82283	9.64701	4.88681	.52720	1.39667	.03554
1.10	-8.88265	9.15583	4.93222	.37709	1.60269	.04510
1.20	-7.99178	8.66101	4.96162	.20752	1.78465	.05582
1.30	-7.15051	8.16414	4.97320	.02127	1.93538	.06766
1.40	-6.35896	7.66706	4.96545	-.17825	2.04936	.08056
1.50	-5.61705	7.17169	4.93725	-.38717	2.12289	.09448
1.60	-4.92449	6.68036	4.88786	-.60133	2.15398	.10935
1.70	-4.28079	6.19496	4.81696	-.81645	2.14227	.12510
1.80	-3.68524	5.71773	4.72467	-1.02831	2.08889	.14170
1.90	-3.13692	5.25077	4.61152	-1.23284	1.99619	.15908
2.00	-2.63470	4.79614	4.47845	-1.42627	1.86758	.17721
2.10	-2.17725	4.35574	4.32672	-1.60523	1.70724	.19603
2.20	-1.76305	3.93139	4.15795	-1.76676	1.51990	.21552
2.30	-1.39042	3.52469	3.97399	-1.90843	1.31062	.23565
2.40	-1.05751	3.13706	3.77694	-2.02830	1.08461	.25640
2.50	-.76237	2.76970	3.56906	-2.12495	.84703	.27776
2.60	-.50291	2.42355	3.35271	-2.19747	.60288	.29969
2.70	-.27697	2.09936	3.13033	-2.24546	.35691	.32215
2.80	-.08233	1.79761	2.90439	-2.26895	.11361	.34498
2.90	.08326	1.51853	2.67729	-2.26847	-.12072	.36250
3.00	.22208	1.26212	2.45139	-2.24561	-.33312	.37500
3.10	.33638	1.02814	2.22880	-2.20270	-.52140	.38750
3.20	.42840	.81617	2.01140	-2.14219	-.68544	.40000
3.30	.50029	.62562	1.80084	-2.06647	-.82548	.41250
3.40	.55417	.45572	1.59851	-1.97792	-.94209	.42500
3.50	.59206	.30559	1.40558	-1.87885	-1.03610	.43750
3.60	.61588	.17424	1.22300	-1.77146	-1.10859	.45000
3.70	.62746	.06060	1.05149	-1.65785	-1.16081	.46250
3.80	.62852	-.03646	.89156	-1.53997	-1.19419	.47500
3.90	.62065	-.11813	.74357	-1.41962	-1.21028	.48750
4.00	.60534	-.18574	.60747	-1.29846	-1.21069	.50000

APPENDIX I

RESULTS FOR PILES WITH A = 8.00

TABLE 33. COEFFICIENTS FOR PILE WITH POSITIVE MOMENT AT GROUND SURFACE

$A = 8.00$ $\qquad$ $K = (\beta x/8.0)K_{8.0}$

βx	C_y	C_S	C_M	C_V	C_q	$K/K_{8.0}$
.00	-20.77643	18.18893	8.00000	1.00000	.00000	.00000
.10	-18.99771	17.38387	8.09834	.95014	.94988	.01250
.20	-17.29996	16.56949	8.18733	.81495	1.72999	.02500
.30	-15.68406	15.74701	8.25914	.60972	2.35261	.03750
.40	-14.15074	14.91849	8.30755	.34957	2.83014	.05000
.50	-12.70047	14.08657	8.32778	.04838	3.17511	.06250
.60	-11.33345	13.25405	8.31635	-.28120	3.40003	.07500
.70	-10.04957	12.42444	8.27101	-.62780	3.51735	.08750
.80	-8.84837	11.60110	8.19057	-.98129	3.53934	.10000
.90	-7.72904	10.78757	8.07481	-1.33273	3.47807	.11250
1.00	-6.69043	9.98742	7.92433	-1.67437	3.34521	.12500
1.10	-5.73104	9.20389	7.74045	-1.99963	3.15207	.13750
1.20	-4.84903	8.44039	7.52509	-2.30303	2.90941	.15000
1.30	-4.04224	7.69990	7.28067	-2.58013	2.62746	.16250
1.40	-3.30824	6.98519	7.00999	-2.82747	2.31577	.17500
1.50	-2.64432	6.29876	6.71618	-3.04254	1.98324	.18750
1.60	-2.04754	5.64266	6.40255	-3.22367	1.63803	.20000
1.70	-1.51477	5.01880	6.07254	-3.36994	1.28756	.21250
1.80	-1.04272	4.42861	5.72965	-3.48123	.93845	.22500
1.90	-.62796	3.87321	5.37737	-3.55791	.59656	.23750
2.00	-.26697	3.35337	5.01912	-3.60098	.26697	.25000
2.10	.04383	2.86948	4.65818	-3.61180	-.04602	.26250
2.20	.30806	2.42170	4.29769	-3.59240	-.33886	.27500
2.30	.52930	2.00983	3.94056	-3.54494	-.60870	.28750
2.40	.71113	1.63338	3.58950	-3.47164	-.85336	.30000
2.50	.85707	1.29164	3.24695	-3.37521	-1.07133	.31250
2.60	.97052	.98361	2.91510	-3.25835	-1.26167	.32500
2.70	1.05481	.70816	2.59583	-3.12387	-1.42400	.33750
2.80	1.11313	.46394	2.29079	-2.97454	-1.55839	.35000
2.90	1.14853	.24946	2.00130	-2.81316	-1.66538	.36250
3.00	1.16391	.06310	1.72845	-2.64241	-1.74587	.37500
3.10	1.16198	-.09684	1.47303	-2.46488	-1.80108	.38750
3.20	1.14531	-.23213	1.23561	-2.28303	-1.83250	.40000
3.30	1.11627	-.34460	1.01649	-2.09916	-1.84185	.41250
3.40	1.07705	-.43608	.81577	-1.91538	-1.83099	.42500
3.50	1.02966	-.50841	.63335	-1.73361	-1.80190	.43750
3.60	.97591	-.56339	.46893	-1.55557	-1.75665	.45000
3.70	.91747	-.60281	.32207	-1.38278	-1.69732	.46250
3.80	.85579	-.62840	.19217	-1.21653	-1.62600	.47500
3.90	.79217	-.64182	.07852	-1.05793	-1.54474	.48750
4.00	.72776	-.64475	-.01967	-.90777	-1.45552	.50000

TABLE 34. COEFFICIENTS FOR PILE WITH POSITIVE MOMENT AT GROUND SURFACE

A = 8.00 R = 2.75 T = 2.275

βx	C_y	C_S	C_M	C_V	C_q	$K/K_{8.0}$
.00	-25.21787	20.28411	8.00000	1.00000	-.00000	-.00000
.10	-23.22962	19.47900	8.09988	.99509	.13505	.00145
.20	-21.32238	18.66407	8.19824	.96560	.47670	.00558
.30	-19.49711	17.83952	8.29173	.89538	.94225	.01208
.40	-17.75475	17.00606	8.37575	.77524	1.46454	.02062
.50	-16.09614	16.16494	8.44512	.60235	1.99046	.03091
.60	-14.52196	15.31774	8.49462	.37846	2.47948	.04268
.70	-13.03271	14.46685	8.51938	.10881	2.90214	.05567
.80	-11.62862	13.61489	8.51519	-.19891	3.23869	.06962
.90	-10.30967	12.76495	8.47870	-.53544	3.47765	.08433
1.00	-9.07546	11.92042	8.40751	-.89082	3.61453	.09956
1.10	-7.92531	11.08473	8.30027	-1.25479	3.65051	.11515
1.20	-6.85912	10.26162	8.15660	-1.61755	3.59123	.13091
1.30	-5.87248	9.45468	7.97708	-1.96098	3.44575	.14669
1.40	-4.96657	8.66743	7.76317	-2.30404	3.22542	.16235
1.50	-4.13827	7.90321	7.51706	-2.61287	2.94310	.17779
1.60	-3.38512	7.16506	7.24156	-2.89094	2.61225	.19292
1.70	-2.70435	6.45581	6.93997	-3.13408	2.24635	.20766
1.80	-2.09297	5.77787	6.61593	-3.33943	1.85831	.22197
1.90	-1.54773	5.13328	6.27332	-3.50538	1.46001	.23583
2.00	-1.06521	4.52374	5.91610	-3.63145	1.06202	.24925
2.10	-.64185	3.95044	5.54826	-3.71812	.67336	.26227
2.20	-.27396	3.41431	5.17367	-3.76671	.30133	.27497
2.30	.04218	2.91582	4.79605	-3.77917	-.04851	.28750
2.40	.31038	2.45509	4.41889	-3.75793	-.37246	.30000
2.50	.53438	2.03192	4.04543	-3.70560	-.66798	.31250
2.60	.71792	1.64578	3.67863	-3.62540	-.93330	.32500
2.70	.86467	1.29587	3.32113	-3.52014	-1.16731	.33750
2.80	.97820	.98114	2.97528	-3.39307	-1.36948	.35000
2.90	1.06197	.70033	2.64310	-3.24737	-1.53985	.36250
3.00	1.11929	.45198	2.32629	-3.08620	-1.67893	.37500
3.10	1.15333	.23448	2.02625	-2.91266	-1.78766	.38750
3.20	1.16710	.04610	1.74405	-2.72970	-1.86736	.40000
3.30	1.16341	-.11498	1.48051	-2.54016	-1.91963	.41250
3.40	1.14490	-.25067	1.23615	-2.34668	-1.94633	.42500
3.50	1.11401	-.36290	1.01122	-2.15172	-1.94952	.43750
3.60	1.07300	-.45360	.80578	-1.95753	-1.93140	.45000
3.70	1.02390	-.52473	.61963	-1.76612	-1.89423	.46250
3.80	.96860	-.57820	.45241	-1.57927	-1.84035	.47500
3.90	.90876	-.61586	.30358	-1.39855	-1.77209	.48750
4.00	.84587	-.63966	.17248	-1.22519	-1.69175	.50000

TABLE 35. COEFFICIENTS FOR PILE WITH POSITIVE MOMENT AT GROUND SURFACE

A = 8.00 B = 1.35 T = 2.525

βy	C_y	C_S	C_M	C_V	C_q	$K/K_{8.0}$
.00	-30.04253	22.23791	8.00000	1.00000	-.00000	-.00000
.10	-27.85891	21.43280	8.09994	.99733	.07395	.00066
.20	-25.75628	20.61784	8.19903	.98083	.27152	.00263
.30	-23.73565	19.79309	8.29533	.93985	.55887	.00588
.40	-21.79796	18.95897	8.38600	.86696	.90555	.01038
.50	-19.94412	18.11626	8.46758	.75760	1.28454	.01610
.60	-18.17495	17.26591	8.53631	.60975	1.67221	.02300
.70	-16.49113	16.40955	8.58833	.42357	2.04823	.03105
.80	-14.89317	15.54897	8.61989	.20112	2.39555	.04021
.90	-13.38139	14.68642	8.62753	-.05402	2.70029	.05044
1.00	-11.95587	13.82446	8.60822	-.33704	2.95163	.06171
1.10	-10.61640	12.96582	8.55943	-.64218	3.14167	.07398
1.20	-9.36250	12.11365	8.47929	-.96302	3.26526	.08718
1.30	-8.19337	11.27112	8.36655	-1.29278	3.31980	.10129
1.40	-7.10788	10.44152	8.22067	-1.62453	3.30503	.11624
1.50	-6.10456	9.62819	8.04180	-1.95140	3.22279	.13198
1.60	-5.18163	8.83430	7.83075	-2.26682	3.07675	.14844
1.70	-4.33699	8.06310	7.58898	-2.56467	2.87217	.16556
1.80	-3.56821	7.31753	7.31854	-2.83941	2.61559	.18325
1.90	-2.87259	6.60032	7.02197	-3.08622	2.31459	.20143
2.00	-2.24717	5.91397	6.70230	-3.30106	1.97752	.22000
2.10	-1.68876	5.26057	6.36286	-3.48076	1.61323	.23881
2.20	-1.19397	4.64196	6.00731	-3.62306	1.23088	.25772
2.30	-.75923	4.05955	5.63946	-3.72662	.83974	.27650
2.40	-.38089	3.51437	5.26321	-3.79103	.44917	.29481
2.50	-.05517	3.00708	4.88246	-3.81682	.06883	.31188
2.60	.22171	2.53790	4.50101	-3.80562	-.28822	.32500
2.70	.45359	2.10677	4.12241	-3.76034	-.61235	.33750
2.80	.64424	1.71321	3.74990	-3.68437	-.90194	.35000
2.90	.79739	1.35647	3.38638	-3.58121	-1.15621	.36250
3.00	.91666	1.03553	3.03440	-3.45439	-1.37499	.37500
3.10	1.00558	.74911	2.69613	-3.30745	-1.55865	.38750
3.20	1.06752	.49576	2.37343	-3.14387	-1.70803	.40000
3.30	1.10571	.27383	2.06777	-2.96701	-1.82443	.41250
3.40	1.12321	.08156	1.78034	-2.78010	-1.90947	.42500
3.50	1.12290	-.08291	1.51197	-2.58616	-1.96507	.43750
3.60	1.10744	-.22152	1.26324	-2.38805	-1.99340	.45000
3.70	1.07934	-.33626	1.03441	-2.18837	-1.99679	.46250
3.80	1.04088	-.42911	.82554	-1.98949	-1.97768	.47500
3.90	.99415	-.50206	.63642	-1.79354	-1.93859	.48750
4.00	.94103	-.55724	.46668	-1.60232	-1.88207	.50000

TABLE 36. COEFFICIENTS FOR PILE WITH POSITIVE MOMENT AT GROUND SURFACE

A = 8.00 B = 1.05 U = 3.50 T = 2.725

βx	C_y	C_S	C_M	C_V	C_q	$K/K_{8.0}$
.00	-35.49451	24.37566	8.00000	1.00000	-.00000	-.00000
.10	-33.09711	23.57055	8.10000	.99978	.00781	.00005
.20	-30.78071	22.75556	8.19988	.99704	.05544	.00045
.30	-28.54631	21.93060	8.29917	.98647	.16542	.00144
.40	-26.39490	21.09579	8.39672	.96143	.34550	.00327
.50	-24.32745	20.25143	8.49077	.91499	.59245	.00608
.60	-22.34490	19.39784	8.57885	.84095	.89544	.01001
.70	-20.44814	18.53593	8.65795	.73447	1.23873	.01514
.80	-18.63795	17.66670	8.72463	.59242	1.60402	.02151
.90	-16.91499	16.79157	8.77528	.41356	1.97225	.02914
1.00	-15.27976	15.91238	8.80621	.19852	2.32502	.03804
1.10	-13.73258	15.03115	8.81392	-.05030	2.64571	.04816
1.20	-12.27351	14.15049	8.79522	-.32898	2.92014	.05948
1.30	-10.90238	13.27314	8.74736	-.63229	3.13710	.07193
1.40	-9.61869	12.40213	8.66818	-.95408	3.28853	.08547
1.50	-8.42165	11.54071	8.55618	-1.28750	3.36954	.10002
1.60	-7.31014	10.69209	8.41054	-1.62542	3.37825	.11553
1.70	-6.28272	9.85976	8.23118	-1.96062	3.31554	.13193
1.80	-5.33758	9.04703	8.01872	-2.28611	3.18465	.14916
1.90	-4.47259	8.25715	7.77447	-2.59532	2.99081	.16717
2.00	-3.68533	7.49322	7.50035	-2.88228	2.74075	.18592
2.10	-2.97305	6.75806	7.19887	-3.14176	2.44234	.20537
2.20	-2.33273	6.05430	6.87300	-3.36934	2.10409	.22549
2.30	-1.76113	5.38420	6.52611	-3.56148	1.73485	.24626
2.40	-1.25478	4.74969	6.16189	-3.71553	1.34347	.26767
2.50	-.81003	4.15232	5.78425	-3.82970	.93858	.28967
2.60	-.42311	3.59318	5.39723	-3.90306	.52841	.31221
2.70	-.09017	3.07305	5.00492	-3.93547	.12085	.33505
2.80	.19272	2.59224	4.61139	-3.92778	-.26981	.35000
2.90	.42950	2.15068	4.22053	-3.88286	-.62278	.36250
3.00	.62407	1.74793	3.83586	-3.80463	-.93611	.37500
3.10	.78028	1.38318	3.46052	-3.69706	-1.20944	.38750
3.20	.90187	1.05539	3.09724	-3.56415	-1.44299	.40000
3.30	.99248	.76323	2.74836	-3.40984	-1.63759	.41250
3.40	1.05559	.50515	2.41582	-3.23797	-1.79450	.42500
3.50	1.09452	.27944	2.10120	-3.05221	-1.91542	.43750
3.60	1.11243	.08423	1.80570	-2.85608	-2.00238	.45000
3.70	1.11227	-.08241	1.53021	-2.65286	-2.05770	.46250
3.80	1.09678	-.22253	1.27526	-2.44558	-2.08389	.47500
3.90	1.06853	-.33819	1.04113	-2.23702	-2.08363	.48750
4.00	1.02985	-.43170	.82782	-2.02965	-2.05970	.50000

TABLE 37. COEFFICIENTS FOR PILE WITH POSITIVE MOMENT AT GROUND SURFACE

A = 8.00 B = 1.05 U = 1.80 T = 2.900

βW	C_y	C_S	C_M	C_V	C_q	$K/K_{8.0}$
.00	-40.03365	26.01140	8.00000	1.00000	-.00000	-.00000
.10	-37.47268	25.20629	8.10000	.99988	.00414	.00002
.20	-34.99271	24.39130	8.19994	.99838	.03053	.00021
.30	-32.59473	23.56632	8.29954	.99244	.09451	.00072
.40	-30.27975	22.73143	8.39815	.97783	.20488	.00169
.50	-28.04875	21.88682	8.49468	.94970	.36479	.00325
.60	-25.90269	21.03262	8.58752	.90316	.57269	.00552
.70	-23.84251	20.16947	8.67459	.83365	.82322	.00863
.80	-21.86906	19.29800	8.75341	.73730	1.10805	.01266
.90	-19.98314	18.41918	8.82112	.61120	1.41667	.01772
1.00	-18.18541	17.53432	8.87466	.45355	1.73717	.02388
1.10	-16.47642	16.64486	8.91082	.26379	2.05691	.03120
1.20	-14.85652	15.75284	8.92643	.04264	2.36315	.03976
1.30	-13.32586	14.86042	8.91843	-.20793	2.64365	.04959
1.40	-11.88437	13.97009	8.88402	-.48478	2.88714	.06073
1.50	-10.53169	13.08467	8.82079	-.78369	3.08370	.07320
1.60	-9.26719	12.20703	8.72676	-1.09957	3.22517	.08700
1.70	-8.08994	11.34043	8.60052	-1.42655	3.30531	.10214
1.80	-6.99866	10.48810	8.44130	-1.75831	3.32005	.11859
1.90	-5.99176	9.65335	8.24892	-2.08818	3.26746	.13633
2.00	-5.06733	8.83950	8.02393	-2.40943	3.14786	.15530
2.10	-4.22311	8.04969	7.76751	-2.71546	2.96364	.17544
2.20	-3.45654	7.28703	7.48151	-3.00002	2.71919	.19667
2.30	-2.76476	6.55435	7.16836	-3.25738	2.42064	.21888
2.40	-2.14465	5.85422	6.83104	-3.48250	2.07563	.24195
2.50	-1.59282	5.18890	6.47300	-3.67119	1.69304	.26572
2.60	-1.10572	4.56022	6.09805	-3.82013	1.28270	.29001
2.70	-.67958	3.96073	5.71029	-3.92710	.85508	.31456
2.80	-.31054	3.41847	5.31398	-3.99092	.42111	.33900
2.90	.00535	2.90709	4.91346	-4.01151	-.00776	.36250
3.00	.27212	2.43579	4.51299	-3.99039	-.40819	.37500
3.10	.49376	2.00435	4.11656	-3.93140	-.76533	.38750
3.20	.67423	1.61220	3.72776	-3.83888	-1.07876	.40000
3.30	.81740	1.25842	3.34970	-3.71719	-1.34872	.41250
3.40	.92707	.94179	2.98509	-3.57064	-1.57603	.42500
3.50	1.00688	.66085	2.63622	-3.40344	-1.76204	.43750
3.60	1.06031	.41393	2.30493	-3.21963	-1.90856	.45000
3.70	1.09068	.19919	1.99269	-3.02305	-2.01775	.46250
3.80	1.10110	.01468	1.70060	-2.81732	-2.09209	.47500
3.90	1.09450	-.14166	1.42941	-2.60577	-2.13428	.48750
4.00	1.07359	-.27220	1.17953	-2.39150	-2.14718	.50000

TABLE 38. COEFFICIENTS FOR PILE WITH POSITIVE MOMENT AT GROUND SURFACE

A = 8.00 B = 1.05 U = 1.10 T = 3.100

βx	C_y	C_S	C_M	C_V	C_q	$K/K_{8.0}$
.00	-45.55685	27.85292	8.00000	1.00000	-.00000	-.00000
.10	-42.81172	27.04781	8.10000	.99993	.00256	.00001
.20	-40.14760	26.23281	8.19996	.99898	.01920	.00011
.30	-37.56547	25.40783	8.29971	.99521	.06049	.00040
.40	-35.06634	24.57290	8.39882	.98576	.13350	.00095
.50	-32.65120	23.72817	8.49658	.96724	.24214	.00185
.60	-30.32102	22.87367	8.59188	.93603	.38750	.00319
.70	-28.07676	22.00988	8.68327	.88849	.56820	.00505
.80	-25.91932	21.13722	8.76896	.82126	.78073	.00753
.90	-23.84957	20.25636	8.84681	.73140	1.01983	.01069
1.00	-21.86827	19.36827	8.91446	.61658	1.27883	.01461
1.10	-19.97611	18.47393	8.96930	.47820	1.54997	.01939
1.20	-18.17364	17.57491	9.00864	.30646	1.82481	.02510
1.30	-16.46123	16.67285	9.02974	.11042	2.09448	.03180
1.40	-14.83910	15.76970	9.02990	-.11194	2.35006	.03959
1.50	-13.30725	14.86774	9.00658	-.35878	2.58286	.04852
1.60	-11.86545	13.96931	8.95746	-.62742	2.78470	.05867
1.70	-10.51319	13.07720	8.88053	-.91436	2.94815	.07010
1.80	-9.24971	12.19425	8.77415	-1.21546	3.06677	.08288
1.90	-8.07395	11.32346	8.63714	-1.52594	3.13526	.09707
2.00	-6.98454	10.46796	8.46883	-1.84059	3.14966	.11273
2.10	-5.97979	9.63081	8.26907	-2.15387	3.10739	.12991
2.20	-5.05770	8.81522	8.03828	-2.46002	3.00735	.14865
2.30	-4.21597	8.02422	7.77746	-2.75330	2.84994	.16899
2.40	-3.45199	7.26074	7.48820	-3.02804	2.63699	.19097
2.50	-2.76287	6.52754	7.17260	-3.27885	2.37177	.21461
2.60	-2.14546	5.82706	6.83333	-3.50071	2.05882	.23990
2.70	-1.59636	5.16159	6.47351	-3.68913	1.70388	.26683
2.80	-1.11199	4.53297	6.09668	-3.84024	1.31372	.29535
2.90	-.68857	3.94272	5.70673	-3.95090	.89604	.32532
3.00	-.32220	3.39196	5.30784	-4.01877	.45942	.35646
3.10	-.00892	2.88132	4.90436	-4.04246	.01383	.38750
3.20	.25532	2.41108	4.50072	-4.02238	-.40851	.40000
3.30	.47455	1.98104	4.10113	-3.96245	-.78301	.41250
3.40	.65276	1.59059	3.70932	-3.86747	-1.10970	.42500
3.50	.79388	1.23879	3.32858	-3.74218	-1.38929	.43750
3.60	.90170	.92438	2.96169	-3.59123	-1.62306	.45000
3.70	.97988	.64588	2.61100	-3.41913	-1.81278	.46250
3.80	1.03195	.40155	2.27839	-3.23015	-1.96070	.47500
3.90	1.06120	.18951	1.96536	-3.02838	-2.06935	.48750
4.00	1.07079	.00745	1.67299	-2.81763	-2.14159	.50000

APPENDIX J

RESULTS FOR PILES WITH $V_o = 0.00$ AND $M_o = 1.00$

TABLE 39. COEFFICIENTS FOR PILE WITH POSITIVE MOMENT AT GROUND SURFACE

V_o = .00 $K = (\beta x/8.0)K_{8.0}$

βx	C_y	C_S	C_M	C_V	C_q	$K/K_{8.0}$
.00	-2.13680	2.00651	1.00000	.00000	.00000	.00000
.10	-1.94115	1.90652	.99983	-.00510	.09705	.01250
.20	-1.75550	1.80658	.99870	-.01886	.17555	.02500
.30	-1.57983	1.70684	.99583	-.03961	.23697	.03750
.40	-1.41412	1.60749	.99061	-.06570	.28282	.05000
.50	-1.25831	1.50882	.98257	-.09567	.31457	.06250
.60	-1.11232	1.41109	.97140	-.12817	.33369	.07500
.70	-.97605	1.31465	.95689	-.16201	.34161	.08750
.80	-.84934	1.21983	.93898	-.19615	.33973	.10000
.90	-.73202	1.12697	.91768	-.22964	.32941	.11250
1.00	-.62387	1.03642	.89309	-.26178	.31193	.12500
1.10	-.52466	.94846	.86539	-.29184	.28856	.13750
1.20	-.43409	.86343	.83481	-.31932	.26045	.15000
1.30	-.35187	.78159	.80162	-.34380	.22871	.16250
1.40	-.27766	.70319	.76615	-.36497	.19436	.17500
1.50	-.21112	.62844	.72873	-.38262	.15834	.18750
1.60	-.15185	.55750	.68974	-.39661	.12148	.20000
1.70	-.09949	.49053	.64953	-.40691	.08457	.21250
1.80	-.05362	.42762	.60847	-.41355	.04826	.22500
1.90	-.01384	.36885	.56693	-.41661	.01314	.23750
2.00	.02027	.31424	.52525	-.41624	-.02027	.25000
2.10	.04913	.26379	.48378	-.41263	-.05159	.26250
2.20	.07316	.21747	.44282	-.40601	-.08048	.27500
2.30	.09276	.17520	.40266	-.39663	-.10667	.28750
2.40	.10833	.13690	.36357	-.38477	-.12999	.30000
2.50	.12026	.10244	.32578	-.37073	-.15032	.31250
2.60	.12893	.07169	.28948	-.35481	-.16761	.32500
2.70	.13471	.04448	.25486	-.33732	-.18186	.33750
2.80	.13793	.02065	.22206	-.31855	-.19311	.35000
2.90	.13894	.00000	.19118	-.29880	-.20146	.36250
3.00	.13803	-.01765	.16232	-.27835	-.20705	.37500
3.10	.13549	-.03253	.13552	-.25748	-.21002	.38750
3.20	.13160	-.04483	.11083	-.23643	-.21057	.40000
3.30	.12660	-.05477	.08823	-.21545	-.20890	.41250
3.40	.12072	-.06255	.06773	-.19473	-.20522	.42500
3.50	.11415	-.06839	.04927	-.17446	-.19977	.43750
3.60	.10709	-.07248	.03281	-.15482	-.19277	.45000
3.70	.09971	-.07502	.01828	-.13595	-.18446	.46250
3.80	.09213	-.07620	.00560	-.11797	-.17506	.47500
3.90	.08450	-.07620	-.00533	-.10097	-.16478	.48750
4.00	.07692	-.07520	-.01462	-.08502	-.15385	.50000

TABLE 40. COEFFICIENTS FOR PILE WITH POSITIVE MOMENT AT GROUND SURFACE

V_o = .00 R = 2.75 T = 2.125

βX	C_y	C_S	C_M	C_V	C_q	$K/K_{8.0}$
.00	-2.53937	2.19883	1.00000	.00000	-.00000	-.00000
.10	-2.32448	2.09883	.99999	-.00053	.01442	.00155
.20	-2.11960	1.99884	.99981	-.00365	.05044	.00595
.30	-1.92472	1.89888	.99912	-.01105	.09873	.01282
.40	-1.73982	1.79905	.99744	-.02357	.15186	.02182
.50	-1.56490	1.69947	.99424	-.04139	.20414	.03261
.60	-1.39992	1.60027	.98901	-.06421	.25132	.04488
.70	-1.24482	1.50174	.98127	-.09137	.29050	.05834
.80	-1.09954	1.40412	.97063	-.12196	.31983	.07271
.90	-.96396	1.30772	.95680	-.15496	.33841	.08776
1.00	-.83795	1.21289	.93959	-.18926	.34609	.10325
1.10	-.72133	1.11993	.91894	-.22380	.34330	.11898
1.20	-.61389	1.02921	.89486	-.25758	.33093	.13476
1.30	-.51640	.94107	.86747	-.28969	.31017	.15045
1.40	-.42559	.85583	.83700	-.31937	.28243	.16590
1.50	-.34414	.77378	.80370	-.34598	.24918	.18102
1.60	-.27072	.69518	.76791	-.36907	.21194	.19572
1.70	-.20498	.62027	.73000	-.38828	.17215	.20995
1.80	-.14655	.54924	.69038	-.40345	.13114	.22371
1.90	-.09501	.48224	.64944	-.41451	.09007	.23700
2.00	-.04997	.41939	.60760	-.42150	.04995	.24989
2.10	-.01100	.36074	.56526	-.42456	.01155	.26249
2.20	.02230	.30634	.52281	-.42390	-.02453	.27500
2.30	.05039	.25617	.48059	-.41978	-.05795	.28750
2.40	.07367	.21020	.43896	-.41241	-.08840	.30000
2.50	.09256	.16835	.39820	-.40218	-.11570	.31250
2.60	.10746	.13052	.35860	-.38939	-.13970	.32500
2.70	.11878	.09658	.32040	-.37436	-.16036	.33750
2.80	.12690	.06638	.28379	-.35743	-.17766	.35000
2.90	.13217	.03976	.24896	-.33894	-.19165	.36250
3.00	.13495	.01652	.21604	-.31922	-.20243	.37500
3.10	.13557	-.00352	.18514	-.29856	-.21014	.38750
3.20	.13434	-.02056	.15635	-.27729	-.21495	.40000
3.30	.13155	-.03487	.12970	-.25567	-.21705	.41250
3.40	.12745	-.04660	.10522	-.23397	-.21667	.42500
3.50	.12230	-.05599	.08290	-.21241	-.21403	.43750
3.60	.11632	-.06325	.06272	-.19123	-.20938	.45000
3.70	.10971	-.06860	.04464	-.17060	-.20297	.46250
3.80	.10265	-.07225	.02858	-.15069	-.19504	.47500
3.90	.09531	-.07439	.01447	-.13164	-.18585	.48750
4.00	.08782	-.07522	.00222	-.11354	-.17564	.50000

TABLE 41. COEFFICIENTS FOR PILE WITH POSITIVE
MOMENT AT GROUND SURFACE

V_o = .00 R =1.35 T = 2.350

βx	C_y	C_S	C_M	C_V	C_q	$K/K_{8.0}$
.00	-2.96931	2.37680	1.00000	.00000	-.00000	-.00000
.10	-2.73663	2.27680	.99999	-.00028	.00780	.00071
.20	-2.51395	2.17680	.99990	-.00201	.02844	.00282
.30	-2.30127	2.07683	.99951	-.00629	.05812	.00631
.40	-2.09859	1.97692	.99854	-.01384	.09345	.01113
.50	-1.90588	1.87717	.99663	-.02508	.13150	.01724
.60	-1.72315	1.77764	.99340	-.04015	.16972	.02462
.70	-1.55034	1.67854	.98848	-.05895	.20598	.03321
.80	-1.38742	1.58002	.98150	-.08121	.23854	.04299
.90	-1.23431	1.48232	.97214	-.10648	.26601	.05387
1.00	-1.09092	1.38569	.96013	-.13420	.28737	.06585
1.10	-.95713	1.29040	.94525	-.16371	.30192	.07886
1.20	-.83279	1.19674	.92735	-.19433	.30926	.09284
1.30	-.71772	1.10503	.90637	-.22531	.30929	.10773
1.40	-.61171	1.01558	.88230	-.25593	.30212	.12347
1.50	-.51453	.92869	.85522	-.28540	.28811	.13999
1.60	-.42589	.84464	.82526	-.31333	.26780	.15720
1.70	-.34550	.76373	.79263	-.33885	.24187	.17501
1.80	-.27304	.68620	.75758	-.36154	.21114	.19332
1.90	-.20815	.61228	.72042	-.38094	.17651	.21199
2.00	-.15046	.54218	.68150	-.39673	.13895	.23087
2.10	-.09959	.47603	.64119	-.40867	.09949	.24975
2.20	-.05513	.41397	.59989	-.41660	.05916	.26829
2.30	-.01666	.35608	.55800	-.42051	.01936	.28591
2.40	.01621	.30238	.51592	-.42047	-.01945	.30000
2.50	.04394	.25289	.47402	-.41673	-.05492	.31250
2.60	.06692	.20756	.43268	-.40960	-.08710	.32500
2.70	.08558	.16632	.39220	-.39945	-.11553	.33750
2.80	.10031	.12908	.35287	-.38663	-.14043	.35000
2.90	.11151	.09570	.31494	-.37149	-.16170	.36250
3.00	.11957	.06603	.27863	-.35441	-.17935	.37500
3.10	.12483	.03991	.24411	-.33575	-.19348	.38750
3.20	.12765	.01714	.21152	-.31583	-.20425	.40000
3.30	.12836	-.00247	.18097	-.29501	-.21179	.41250
3.40	.12725	-.01913	.15254	-.27358	-.21633	.42500
3.50	.12462	-.03305	.12627	-.25184	-.21809	.43750
3.60	.12072	-.04446	.10217	-.23005	-.21730	.45000
3.70	.11580	-.05356	.08025	-.20846	-.21423	.46250
3.80	.11007	-.06058	.06047	-.18728	-.20914	.47500
3.90	.10374	-.06573	.04278	-.16669	-.20230	.48750
4.00	.09698	-.06922	.02710	-.14684	-.19397	.50000

TABLE 42. COEFFICIENTS FOR PILE WITH POSITIVE MOMENT AT GROUND SURFACE

V_o = .00 R = 1.05 U = 3.50 T = 2.550

βy	C_y	C_S	C_M	C_V	C_q	$K/K_{B.O}$
.00	-3.44854	2.56875	1.00000	.00000	-.00000	-.00000
.10	-3.19667	2.46875	1.00000	-.00002	.00085	.00006
.20	-2.95479	2.36875	.99999	-.00033	.00603	.00051
.30	-2.72292	2.26875	.99991	-.00147	.01754	.00163
.40	-2.50104	2.16877	.99965	-.00415	.03689	.00368
.50	-2.28916	2.06885	.99901	-.00908	.06260	.00683
.60	-2.08727	1.96899	.99774	-.01686	.09360	.01121
.70	-1.89536	1.86932	.99553	-.02793	.12804	.01688
.80	-1.71340	1.76993	.99204	-.04252	.16386	.02390
.90	-1.54136	1.67097	.98692	-.06068	.19901	.03227
1.00	-1.37918	1.57263	.97980	-.08227	.23157	.04197
1.10	-1.22681	1.47509	.97037	-.10684	.25991	.05296
1.20	-1.08413	1.37864	.95835	-.13402	.28267	.06518
1.30	-.95104	1.28352	.94351	-.16314	.29889	.07857
1.40	-.82737	1.19004	.92568	-.19354	.30795	.09305
1.50	-.71297	1.09850	.90479	-.22447	.30958	.10855
1.60	-.60760	1.00920	.88080	-.25519	.30381	.12500
1.70	-.51105	.92245	.85378	-.28498	.29097	.14234
1.80	-.42302	.83854	.82385	-.31316	.27159	.16050
1.90	-.34324	.75777	.79121	-.33910	.24677	.17944
2.00	-.27136	.68039	.75612	-.36226	.21614	.19912
2.10	-.20705	.60663	.71886	-.38218	.18180	.21951
2.20	-.14992	.53668	.67980	-.39850	.14428	.24059
2.30	-.09959	.47072	.63928	-.41096	.10450	.26232
2.40	-.05565	.40886	.59773	-.41936	.06336	.28466
2.50	-.01768	.35120	.55554	-.42361	.02175	.30746
2.60	.01471	.29776	.51314	-.42373	-.01913	.32500
2.70	.04199	.24856	.47092	-.41991	-.05669	.33750
2.80	.06456	.20356	.42927	-.41253	-.09038	.35000
2.90	.08283	.16268	.38851	-.40197	-.12011	.36250
3.00	.09722	.12581	.34896	-.38865	-.14583	.37500
3.10	.10812	.09283	.31086	-.37295	-.16758	.38750
3.20	.11590	.06358	.27443	-.35527	-.18545	.40000
3.30	.12094	.03788	.23986	-.33590	-.19956	.41250
3.40	.12358	.01554	.20727	-.31548	-.21010	.42500
3.50	.12415	-.00365	.17679	-.29409	-.21727	.43750
3.60	.12295	-.01989	.14847	-.27214	-.22131	.45000
3.70	.12026	-.03342	.12237	-.24993	-.22248	.46250
3.80	.11634	-.04445	.09849	-.22773	-.22106	.47500
3.90	.11144	-.05320	.07681	-.20580	-.21731	.48750
4.00	.10577	-.05990	.05731	-.18433	-.21154	.50000

TABLE 43. COEFFICIENTS FOR PILE WITH POSITIVE MOMENT AT GROUND SURFACE

V_o = .00 R = 1.05 U = 1.80 T = 2.700

βX	C_y	C_S	C_M	C_V	C_q	$K/K_{8.0}$
.00	-3.82785	2.70932	1.00000	.00000	-.00000	-.00000
.10	-3.56191	2.60932	1.00000	-.00001	.00045	.00003
.20	-3.30598	2.50932	.99999	-.00018	.00332	.00025
.30	-3.06005	2.40933	.99995	-.00082	.01020	.00083
.40	-2.82412	2.30934	.99980	-.00239	.02194	.00194
.50	-2.59818	2.20939	.99943	-.00539	.03874	.00372
.60	-2.38224	2.10947	.99866	-.01031	.06031	.00632
.70	-2.17628	2.00966	.99729	-.01759	.08592	.00987
.80	-1.98030	1.91004	.99506	-.02760	.11456	.01446
.90	-1.79427	1.81069	.99168	-.04057	.14501	.02020
1.00	-1.61815	1.71176	.98685	-.05662	.17593	.02718
1.10	-1.45190	1.61339	.98026	-.07573	.20593	.03546
1.20	-1.29545	1.51578	.97161	-.09773	.23369	.04509
1.30	-1.14871	1.41915	.96063	-.12234	.25795	.05613
1.40	-1.01158	1.32374	.94707	-.14916	.27760	.06860
1.50	-.88392	1.22984	.93075	-.17767	.29172	.08250
1.60	-.76556	1.13770	.91151	-.20728	.29962	.09784
1.70	-.65631	1.04764	.88928	-.23735	.30081	.11458
1.80	-.55596	.95995	.86404	-.26720	.29508	.13269
1.90	-.46424	.87493	.83587	-.29613	.28245	.15210
2.00	-.38088	.79288	.80487	-.32345	.26317	.17273
2.10	-.30556	.71405	.77124	-.34854	.23771	.19448
2.20	-.23796	.63871	.73525	-.37080	.20676	.21722
2.30	-.17770	.56708	.69719	-.38973	.17115	.24078
2.40	-.12442	.49933	.65742	-.40490	.13187	.26495
2.50	-.07771	.43564	.61634	-.41601	.08998	.28947
2.60	-.03716	.37610	.57435	-.42285	.04667	.31395
2.70	-.00236	.32079	.53190	-.42534	.00318	.33750
2.80	.02712	.26972	.48942	-.42357	-.03797	.35000
2.90	.05171	.22289	.44731	-.41789	-.07498	.36250
3.00	.07183	.18023	.40595	-.40873	-.10774	.37500
3.10	.08788	.14166	.36566	-.39650	-.13622	.38750
3.20	.10028	.10705	.32673	-.38163	-.16046	.40000
3.30	.10941	.07626	.28940	-.36455	-.18054	.41250
3.40	.11565	.04911	.25388	-.34566	-.19661	.42500
3.50	.11934	.02542	.22031	-.32536	-.20886	.43750
3.60	.12083	.00497	.18884	-.30402	-.21751	.45000
3.70	.12043	-.01243	.15953	-.28198	-.22281	.46250
3.80	.11844	-.02701	.13245	-.25957	-.22503	.47500
3.90	.11511	-.03900	.10762	-.23707	-.22448	.48750
4.00	.11071	-.04864	.08503	-.21475	-.22143	.50000

TABLE 44. COEFFICIENTS FOR PILE WITH POSITIVE MOMENT AT GROUND SURFACE

V_o = .00 R = 1.05 U = 1.10 T = 2.900

βX	C_y	C_S	C_M	C_V	C_q	$K/K_{8.0}$
.00	-4.30458	2.87307	1.00000	.00000	-.00000	-.00000
.10	-4.02227	2.77307	1.00000	-.00001	.00027	.00001
.20	-3.74996	2.67307	1.00000	-.00011	.00264	.00013
.30	-3.48766	2.57307	.99997	-.00051	.00641	.00045
.40	-3.23535	2.47308	.99988	-.00151	.01406	.00108
.50	-2.99304	2.37311	.99964	-.00345	.02534	.00211
.60	-2.76073	2.27316	.99914	-.00671	.04027	.00364
.70	-2.53841	2.17328	.99824	-.01163	.05861	.00577
.80	-2.32607	2.07353	.99676	-.01854	.07993	.00859
.90	-2.12370	1.97396	.99447	-.02770	.10357	.01219
1.00	-1.93127	1.87468	.99114	-.03931	.12877	.01666
1.10	-1.74875	1.77578	.98653	-.05348	.15467	.02211
1.20	-1.57609	1.67742	.98036	-.07023	.18033	.02860
1.30	-1.41324	1.57977	.97240	-.08950	.20484	.03623
1.40	-1.26011	1.48302	.96239	-.11113	.22725	.04508
1.50	-1.11660	1.38738	.95011	-.13485	.24670	.05523
1.60	-.98259	1.29308	.93537	-.16033	.26239	.06676
1.70	-.85794	1.20039	.91800	-.18717	.27362	.07973
1.80	-.74246	1.10958	.89790	-.21488	.27983	.09422
1.90	-.63595	1.02091	.87501	-.24294	.28057	.11029
2.00	-.53820	.93468	.84932	-.27070	.27557	.12800
2.10	-.44893	.85115	.82088	-.29785	.26470	.14740
2.20	-.36787	.77059	.78980	-.32353	.24810	.16853
2.30	-.29471	.69328	.75624	-.34725	.22566	.19142
2.40	-.22911	.61943	.72042	-.36847	.19884	.21609
2.50	-.17071	.54926	.68264	-.38669	.16560	.24252
2.60	-.11914	.48296	.64319	-.40145	.12898	.27066
2.70	-.07399	.42067	.60247	-.41236	.08891	.30039
2.80	-.03487	.36250	.56085	-.41914	.04624	.33143
2.90	-.00136	.30851	.51878	-.42156	.00158	.36250
3.00	.02695	.25875	.47668	-.41960	-.04043	.37500
3.10	.05051	.21316	.43498	-.41363	-.07829	.38750
3.20	.06971	.17172	.39406	-.40410	-.11154	.40000
3.30	.08498	.13431	.35426	-.39148	-.14022	.41250
3.40	.09670	.10082	.31585	-.37622	-.16439	.42500
3.50	.10526	.07109	.27908	-.35876	-.18421	.43750
3.60	.11103	.04494	.24415	-.33953	-.19985	.45000
3.70	.11435	.02219	.21122	-.31893	-.21156	.46250
3.80	.11557	.00262	.18040	-.29734	-.21958	.47500
3.90	.11497	-.01397	.15177	-.27513	-.22420	.48750
4.00	.11286	-.02784	.12538	-.25261	-.22572	.50000

APPENDIX K

RESULTS FOR PILES WITH J = 0.00

TABLE 45. COEFFICIENTS FOR PILE WITH NEGATIVE MOMENT AT GROUND SURFACE

J = .00 $\qquad$ $K = (\beta Y/8.0)K_{8.0}$

βY	C_y	C_S	C_M	C_V	C_q	$K/K_{8.0}$
.00	-1.40640	.00000	-1.06493	1.00000	.00000	.00000
.10	-1.40124	.10139	-.96505	.99641	.07006	.01250
.20	-1.38643	.19293	-.86586	.98596	.13864	.02500
.30	-1.36296	.27461	-.76806	.96878	.20444	.03750
.40	-1.33181	.34661	-.67231	.94521	.26636	.05000
.50	-1.29394	.40916	-.57921	.91568	.32348	.06250
.60	-1.25026	.46257	-.48934	.88071	.37508	.07500
.70	-1.20170	.50717	-.40322	.84088	.42059	.08750
.80	-1.14909	.54336	-.32129	.79682	.45963	.10000
.90	-1.09327	.57159	-.24396	.74919	.49197	.11250
1.00	-1.03501	.59233	-.17155	.69867	.51750	.12500
1.10	-.97502	.60608	-.10430	.64593	.53626	.13750
1.20	-.91399	.61338	-.04241	.59165	.54839	.15000
1.30	-.85253	.61476	.01399	.53648	.55414	.16250
1.40	-.79121	.61078	.06487	.48103	.55384	.17500
1.50	-.73052	.60198	.11021	.42591	.54789	.18750
1.60	-.67094	.58893	.15008	.37164	.53675	.20000
1.70	-.61285	.57215	.18458	.31872	.52093	.21250
1.80	-.55661	.55219	.21388	.26760	.50095	.22500
1.90	-.50250	.52955	.23817	.21866	.47737	.23750
2.00	-.45077	.50473	.25769	.17223	.45077	.25000
2.10	-.40161	.47818	.27271	.12859	.42169	.26250
2.20	-.35517	.45033	.28350	.08796	.39069	.27500
2.30	-.31157	.42161	.29040	.05050	.35870	.28750
2.40	-.27086	.39238	.29371	.01633	.32504	.30000
2.50	-.23309	.36298	.29377	-.01448	.29137	.31250
2.60	-.19826	.33373	.29092	-.04194	.25774	.32500
2.70	-.16633	.30489	.28549	-.06605	.22455	.33750
2.80	-.13726	.27671	.27781	-.08688	.19217	.35000
2.90	-.11096	.24940	.26821	-.10452	.16090	.36250
3.00	-.08735	.22313	.25700	-.11911	.13102	.37500
3.10	-.06630	.19804	.24448	-.13078	.10277	.38750
3.20	-.04770	.17427	.23093	-.13973	.07632	.40000
3.30	-.03140	.15188	.21661	-.14612	.05182	.41250
3.40	-.01727	.13096	.20178	-.15016	.02937	.42500
3.50	-.00516	.11154	.18664	-.15207	.00904	.43750
3.60	.00507	.09363	.17142	-.15205	-.00913	.45000
3.70	.01360	.07725	.15629	-.15032	-.02517	.46250
3.80	.02057	.06237	.14140	-.14709	-.03909	.47500
3.90	.02612	.04896	.12691	-.14257	-.05095	.48750
4.00	.03041	.03695	.11292	-.13698	-.06082	.50000

TABLE 45. (CONTD.) COEFFICIENTS FOR PILE WITH NEGATIVE MOMENT AT GROUND SURFACE

J = .00 $\qquad$ K = $(\beta X/8.0)K_{8.0}$

βX	C_y	C_S	C_M	C_V	C_q	$K/K_{8.0}$
4.00	.03041	.03695	.11292	-.13698	-.06082	.50000
4.10	.03356	.02635	.09954	-.13047	-.06880	.51250
4.20	.03572	.01703	.08685	-.12327	-.07511	.52500
4.30	.03701	.00895	.07490	-.11553	-.07957	.53750
4.40	.03755	.00202	.06375	-.10741	-.08261	.55000
4.50	.03745	-.00382	.05343	-.09905	-.08426	.56250
4.60	.03681	-.00868	.04395	-.09060	-.08467	.57500
4.70	.03574	-.01264	.03531	-.08216	-.08309	.58750
4.80	.03431	-.01577	.02751	-.07383	-.08235	.60000
4.90	.03260	-.01817	.02053	-.06572	-.07989	.61250
5.00	.03069	-.01991	.01436	-.05788	-.07674	.62500
5.10	.02864	-.02107	.00895	-.05039	-.07304	.63750
5.20	.02649	-.02173	.00427	-.04329	-.06889	.65000
5.30	.02431	-.02195	.00027	-.03662	-.06442	.66250
5.40	.02211	-.02181	-.00306	-.03041	-.05972	.67500
5.50	.01995	-.02136	-.00581	-.02468	-.05488	.68750
5.60	.01785	-.02066	-.00801	-.01943	-.04999	.70000
5.70	.01583	-.01977	-.00972	-.01468	-.04511	.71250
5.80	.01390	-.01873	-.01097	-.01041	-.04032	.72500
5.90	.01208	-.01759	-.01181	-.00661	-.03565	.73750
6.00	.01038	-.01638	-.01230	-.00327	-.03116	.75000
6.10	.00881	-.01514	-.01248	-.00037	-.02687	.76250
6.20	.00735	-.01389	-.01239	.00210	-.02281	.77500
6.30	.00603	-.01267	-.01207	.00419	-.01899	.78750
6.40	.00482	-.01149	-.01156	.00591	-.01543	.80000
6.50	.00373	-.01036	-.01090	.00729	-.01212	.81250
6.60	.00274	-.00931	-.01011	.00838	-.00906	.82500
6.70	.00186	-.00834	-.00924	.00911	-.00624	.83750
6.80	.00107	-.00746	-.00830	.00960	-.00365	.85000
6.90	.00036	-.00668	-.00732	.00985	-.00127	.86250
7.00	-.00026	-.00600	-.00634	.00986	.00092	.87500
7.10	-.00083	-.00541	-.00536	.00967	.00296	.88750
7.20	-.00135	-.00492	-.00441	.00927	.00486	.90000
7.30	-.00182	-.00453	-.00351	.00870	.00665	.91250
7.40	-.00226	-.00422	-.00267	.00798	.00836	.92500
7.50	-.00267	-.00399	-.00192	.00703	.01001	.93750
7.60	-.00306	-.00383	-.00127	.00594	.01163	.95000
7.70	-.00344	-.00373	-.00074	.00470	.01324	.96250
7.80	-.00381	-.00368	-.00034	.00329	.01486	.97500
7.90	-.00417	-.00366	-.00008	.00173	.01650	.98750
8.00	-.00454	-.00365	.00000	.00000	.01817	1.00000

TABLE 46. COEFFICIENTS FOR PILE WITH NEGATIVE MOMENT AT GROUND SURFACE

J = .00 R = 5.00 T = 3.575

βx	C_y	C_S	C_M	C_V	C_q	$K/K_{8.0}$
.00	-1.62242	.00000	-1.15768	1.00000	-.00000	-.00000
.10	-1.61680	.11066	-1.05769	.99961	.01069	.00165
.20	-1.60060	.21143	-.95782	.99720	.04093	.00625
.30	-1.57482	.30224	-.85837	.99109	.08381	.01330
.40	-1.54046	.38314	-.75976	.98007	.13786	.02237
.50	-1.49850	.45424	-.66253	.96330	.19824	.03307
.60	-1.44991	.51572	-.56729	.94032	.26138	.04506
.70	-1.39565	.56779	-.47466	.91103	.32417	.05806
.80	-1.33664	.61076	-.38528	.87550	.38399	.07182
.90	-1.27377	.64498	-.29972	.83441	.43875	.08611
1.00	-1.20790	.67087	-.21855	.78808	.48686	.10076
1.10	-1.13984	.68887	-.14225	.73731	.52721	.11563
1.20	-1.07036	.69950	-.07120	.68293	.55911	.13058
1.30	-1.00016	.70331	-.00574	.62580	.58226	.14554
1.40	-.92989	.70086	.05389	.56670	.59667	.16041
1.50	-.86016	.69274	.10757	.50677	.60262	.17514
1.60	-.79150	.67955	.15524	.44655	.60062	.18970
1.70	-.72439	.66190	.19690	.38690	.59129	.20406
1.80	-.65924	.64038	.23266	.32852	.57541	.21821
1.90	-.59641	.61557	.26267	.27202	.55380	.23213
2.00	-.53621	.58805	.28714	.21793	.52731	.24585
2.10	-.47887	.55833	.30634	.16670	.49680	.25936
2.20	-.42459	.52695	.32058	.11868	.46312	.27268
2.30	-.37352	.49438	.33019	.07416	.42707	.28584
2.40	-.32574	.46106	.33553	.03333	.38939	.29884
2.50	-.28132	.42741	.33698	-.00369	.35078	.31173
2.60	-.24026	.39379	.33491	-.03681	.31167	.32450
2.70	-.20255	.36053	.32973	-.06606	.27320	.33720
2.80	-.16813	.32794	.32182	-.09148	.23527	.34983
2.90	-.13693	.29625	.31156	-.11316	.19850	.36241
3.00	-.10894	.26570	.29930	-.13123	.16325	.37495
3.10	-.08375	.23645	.28542	-.14587	.12981	.38748
3.20	-.06151	.20866	.27023	-.15727	.09841	.39999
3.30	-.04197	.18244	.25406	-.16563	.06925	.41249
3.40	-.02497	.15787	.23719	-.17120	.04265	.42499
3.50	-.01034	.13501	.21989	-.17421	.01810	.43750
3.60	.00208	.11390	.20242	-.17491	-.00375	.45000
3.70	.01249	.09453	.18498	-.17358	-.02310	.46250
3.80	.02104	.07689	.16776	-.17038	-.03998	.47500
3.90	.02792	.06096	.15095	-.16564	-.05445	.48750
4.00	.03329	.04667	.13468	-.15958	-.06658	.50000

TABLE 46. (CONTD.) COEFFICIENTS FOR PILE WITH NEGATIVE MOMENT AT GROUND SURFACE

J = .00 R = 5.00 T = 3.575

βx	C_y	C_S	C_M	C_V	C_q	$K/K_{8.0}$
4.00	.03329	.04667	.13468	-.15958	-.06658	.50000
4.10	.03731	.03400	.11907	-.15240	-.07649	.51250
4.20	.04014	.02284	.10422	-.14434	-.08429	.52500
4.30	.04192	.01313	.09022	-.13561	-.09014	.53750
4.40	.04280	.00476	.07712	-.12638	-.09418	.55000
4.50	.04292	-.00232	.06495	-.11683	-.09657	.56250
4.60	.04238	-.00825	.05375	-.10712	-.09747	.57500
4.70	.04130	-.01311	.04353	-.09738	-.09706	.58750
4.80	.03978	-.01699	.03427	-.08775	-.09549	.60000
4.90	.03793	-.02000	.02597	-.07832	-.09292	.61250
5.00	.03581	-.02222	.01860	-.06919	-.08953	.62500
5.10	.03350	-.02375	.01212	-.06044	-.08544	.63750
5.20	.03107	-.02468	.00650	-.05212	-.08080	.65000
5.30	.02858	-.02508	.00168	-.04429	-.07575	.66250
5.40	.02607	-.02504	-.00237	-.03698	-.07040	.67500
5.50	.02358	-.02463	-.00572	-.03022	-.06487	.68750
5.60	.02115	-.02392	-.00843	-.02401	-.05924	.70000
5.70	.01881	-.02296	-.01055	-.01837	-.05361	.71250
5.80	.01657	-.02183	-.01212	-.01328	-.04805	.72500
5.90	.01445	-.02055	-.01322	-.00875	-.04263	.73750
6.00	.01246	-.01920	-.01389	-.00475	-.03738	.75000
6.10	.01061	-.01779	-.01419	-.00126	-.03236	.76250
6.20	.00890	-.01637	-.01416	.00172	-.02760	.77500
6.30	.00733	-.01496	-.01386	.00426	-.02311	.78750
6.40	.00590	-.01360	-.01332	.00636	-.01891	.80000
6.50	.00461	-.01231	-.01260	.00805	-.01499	.81250
6.60	.00344	-.01109	-.01172	.00936	-.01136	.82500
6.70	.00239	-.00996	-.01073	.01033	-.00801	.83750
6.80	.00144	-.00894	-.00967	.01098	-.00492	.85000
6.90	.00059	-.00803	-.00855	.01132	-.00206	.86250
7.00	-.00016	-.00723	-.00741	.01140	.00057	.87500
7.10	-.00085	-.00655	-.00627	.01122	.00302	.88750
7.20	-.00147	-.00598	-.00517	.01080	.00531	.90000
7.30	-.00205	-.00551	-.00412	.01016	.00748	.91250
7.40	-.00258	-.00515	-.00315	.00930	.00956	.92500
7.50	-.00308	-.00488	-.00227	.00825	.01157	.93750
7.60	-.00356	-.00469	-.00150	.00699	.01354	.95000
7.70	-.00402	-.00457	-.00087	.00554	.01550	.96250
7.80	-.00448	-.00451	-.00040	.00389	.01747	.97500
7.90	-.00493	-.00449	-.00010	.00204	.01947	.98750
8.00	-.00538	-.00448	.00000	.00000	.02152	1.00000

TABLE 47. COEFFICIENTS FOR PILE WITH NEGATIVE MOMENT AT GROUND SURFACE

J = .00 R = 2.75 T = 3.675

βx	C_y	C_S	C_M	C_V	C_q	$K/K_{8.0}$
.00	-1.85802	.00000	-1.22975	1.00000	-.00000	-.00000
.10	-1.85204	.11787	-1.12976	.99975	.00676	.00091
.20	-1.83476	.22585	-1.02984	.99819	.02616	.00356
.30	-1.80718	.32385	-.93020	.99413	.05659	.00782
.40	-1.77030	.41191	-.83113	.98655	.09616	.01357
.50	-1.72511	.49011	-.73302	.97465	.14281	.02069
.60	-1.67259	.55856	-.63635	.95784	.19443	.02906
.70	-1.61370	.61745	-.54163	.93566	.24891	.03856
.80	-1.54939	.66698	-.44939	.90800	.30424	.04909
.90	-1.48058	.70743	-.36020	.87485	.35853	.06054
1.00	-1.40817	.73915	-.27459	.83630	.41011	.07280
1.10	-1.33301	.76250	-.19307	.79297	.45749	.08583
1.20	-1.25592	.77792	-.11613	.74508	.49946	.09942
1.30	-1.17766	.78590	-.04418	.69331	.53504	.11358
1.40	-1.09896	.78695	.02242	.63832	.56353	.12819
1.50	-1.02047	.78162	.08340	.58087	.58446	.14318
1.60	-.94281	.77047	.13854	.52171	.59762	.15846
1.70	-.86654	.75412	.18771	.46162	.60303	.17397
1.80	-.79213	.73314	.23086	.40137	.60089	.18964
1.90	-.72003	.70816	.26800	.34169	.59158	.20540
2.00	-.65061	.67976	.29924	.28328	.57563	.22119
2.10	-.58417	.64851	.32472	.22678	.55370	.23696
2.20	-.52197	.61500	.34467	.17273	.52652	.25266
2.30	-.46122	.57976	.35936	.12163	.49489	.26824
2.40	-.40506	.54330	.36910	.07388	.45962	.28367
2.50	-.35258	.50611	.37425	.02980	.42157	.29891
2.60	-.30385	.46860	.37519	-.01036	.38156	.31393
2.70	-.25886	.43120	.37231	-.04646	.34037	.32871
2.80	-.21759	.39426	.36602	-.07849	.29874	.34323
2.90	-.17998	.35810	.35675	-.10622	.25736	.35748
3.00	-.14594	.32300	.34491	-.12992	.21684	.37145
3.10	-.11534	.28919	.33089	-.14964	.17769	.38514
3.20	-.08805	.25688	.31510	-.16552	.14038	.39855
3.30	-.06391	.22622	.29790	-.17779	.10526	.41172
3.40	-.04275	.19734	.27965	-.18667	.07262	.42465
3.50	-.02439	.17032	.26046	-.19241	.04267	.43739
3.60	-.00863	.14522	.24125	-.19530	.01553	.44998
3.70	.00471	.12207	.22168	-.19562	-.00872	.46250
3.80	.01584	.10088	.20220	-.19366	-.03010	.47500
3.90	.02495	.08162	.18301	-.18970	-.04866	.48750
4.00	.03223	.06424	.16431	-.18404	-.06446	.50000

TABLE 47. (CONTD.) COEFFICIENTS FOR PILE WITH NEGATIVE MOMENT AT GROUND SURFACE

J = .00 R = 2.75 T = 3.675

βx	C_y	C_S	C_M	C_V	C_q	$K/K_{8.0}$
4.00	.03223	.06424	.16431	-.18404	-.06446	.50000
4.10	.03786	.04873	.14625	-.17690	-.07762	.51250
4.20	.04203	.03498	.12897	-.16859	-.08827	.52500
4.30	.04491	.02291	.11256	-.15933	-.09656	.53750
4.40	.04666	.01243	.09712	-.14935	-.10266	.55000
4.50	.04744	.00345	.08271	-.13887	-.10675	.56250
4.60	.04740	-.00414	.06936	-.12806	-.10902	.57500
4.70	.04665	-.01046	.05710	-.11712	-.10964	.58750
4.80	.04534	-.01560	.04593	-.10619	-.10882	.60000
4.90	.04357	-.01968	.03586	-.09540	-.10675	.61250
5.00	.04143	-.02281	.02685	-.08487	-.10359	.62500
5.10	.03903	-.02509	.01887	-.07471	-.09953	.63750
5.20	.03644	-.02662	.01189	-.06499	-.09475	.65000
5.30	.03373	-.02750	.00585	-.05578	-.08938	.66250
5.40	.03095	-.02782	.00071	-.04713	-.08358	.67500
5.50	.02817	-.02767	-.00358	-.03907	-.07749	.68750
5.60	.02543	-.02713	-.00711	-.03164	-.07121	.70000
5.70	.02276	-.02628	-.00993	-.02483	-.06487	.71250
5.80	.02018	-.02517	-.01210	-.01866	-.05854	.72500
5.90	.01773	-.02388	-.01368	-.01312	-.05231	.73750
6.00	.01541	-.02245	-.01474	-.00819	-.04624	.75000
6.10	.01324	-.02094	-.01534	-.00386	-.04039	.76250
6.20	.01122	-.01940	-.01553	-.00011	-.03480	.77500
6.30	.00936	-.01785	-.01538	.00310	-.02949	.78750
6.40	.00765	-.01633	-.01493	.00579	-.02449	.80000
6.50	.00609	-.01487	-.01424	.00801	-.01981	.81250
6.60	.00467	-.01349	-.01334	.00977	-.01543	.82500
6.70	.00339	-.01220	-.01229	.01111	-.01137	.83750
6.80	.00223	-.01103	-.01113	.01205	-.00759	.85000
6.90	.00118	-.00998	-.00989	.01263	-.00408	.86250
7.00	.00023	-.00905	-.00862	.01288	-.00081	.87500
7.10	-.00063	-.00826	-.00733	.01280	.00224	.88750
7.20	-.00142	-.00759	-.00606	.01243	.00512	.90000
7.30	-.00215	-.00704	-.00485	.01178	.00786	.91250
7.40	-.00283	-.00661	-.00371	.01086	.01049	.92500
7.50	-.00348	-.00629	-.00268	.00969	.01305	.93750
7.60	-.00409	-.00607	-.00178	.00825	.01557	.95000
7.70	-.00469	-.00593	-.00104	.00657	.01809	.96250
7.80	-.00528	-.00586	-.00048	.00463	.02062	.97500
7.90	-.00587	-.00583	-.00012	.00244	.02319	.98750
8.00	-.00645	-.00582	.00000	.00000	.02582	1.00000

TABLE 48. COEFFICIENTS FOR PILE WITH NEGATIVE MOMENT AT GROUND SURFACE

J = .00 R = 1.80 T = 3.775

βx	C_y	C_S	C_M	C_V	C_q	$K/K_{8.0}$
.00	-2.11738	.00000	-1.29626	1.00000	-.00000	-.00000
.10	-2.11106	.12452	-1.19627	.99982	.00497	.00058
.20	-2.09279	.23915	-1.09633	.99866	.01953	.00233
.30	-2.06354	.34379	-.99660	.99560	.04286	.00519
.40	-2.02434	.43848	-.89729	.98981	.07392	.00912
.50	-1.97616	.52328	-.79874	.98059	.11148	.01410
.60	-1.91999	.59827	-.70130	.96733	.15419	.02007
.70	-1.85680	.66359	-.60541	.94961	.20061	.027[illegible]1
.80	-1.78756	.71943	-.51153	.92713	.24928	.03486
.90	-1.71321	.76599	-.42014	.89973	.29875	.04359
1.00	-1.63465	.80356	-.33174	.86740	.34762	.05316
1.10	-1.55276	.83246	-.24681	.83027	.39461	.06353
1.20	-1.46841	.85306	-.16582	.78859	.43851	.07465
1.30	-1.38240	.86578	-.08922	.74272	.47828	.08649
1.40	-1.29549	.87108	-.01740	.69311	.513[illegible]4	.099[illegible]
1.50	-1.20840	.86945	.04929	.64031	.54206	.11214
1.60	-1.12180	.86141	.11058	.58492	.56479	.12586
1.70	-1.03630	.84753	.16622	.52759	.58088	.14013
1.80	-.95246	.82837	.21605	.46899	.59012	.15489
1.90	-.87077	.80452	.26000	.40981	.59250	.17010
2.00	-.79168	.77658	.29802	.35072	.58814	.18572
2.10	-.71556	.74513	.33017	.29241	.57732	.20169
2.20	-.64275	.71075	.35655	.23548	.56044	.21798
2.30	-.57349	.67401	.37732	.18051	.538[illegible]0	.23453
2.40	-.50800	.63547	.39273	.12805	.51062	.25129
2.50	-.44643	.59565	.40303	.07854	.47895	.26820
2.60	-.38889	.55504	.40854	.03239	.44370	.28523
2.70	-.33543	.51410	.40962	-.01009	.40563	.30231
2.80	-.28607	.47325	.40665	-.04866	.36547	.31939
2.90	-.24077	.43289	.40002	-.08314	.32399	.33641
3.00	-.19946	.39337	.39015	-.11343	.28189	.35330
3.10	-.16206	.35496	.37746	-.13952	.23986	.37001
3.20	-.12843	.31796	.36237	-.16143	.19854	.38647
3.30	-.09841	.28256	.34530	-.17927	.15850	.40261
3.40	-.07186	.24895	.32664	-.19320	.12025	.41834
3.50	-.04856	.21727	.30678	-.20340	.08423	.43357
3.60	-.02834	.18762	.28607	-.21014	.05081	.44821
3.70	-.01097	.16007	.26485	-.21367	.02029	.46210
3.80	.00374	.13466	.24342	-.21430	-.00710	.47500
3.90	.01602	.11139	.22207	-.21236	-.03124	.48750
4.00	.02608	.09021	.20102	-.20819	-.05216	.50000

TABLE 48. (CONTD.) COEFFICIENTS FOR PILE WITH NEGATIVE MOMENT AT GROUND SURFACE

J = .00 R = 1.80 T = 3.775

βx	C_y	C_S	C_M	C_V	C_q	$K/K_{8.0}$
4.00	.02608	.09021	.20102	-.20819	-.05216	.50000
4.10	.03413	.07116	.18049	-.20204	-.06997	.51250
4.20	.04038	.05411	.16066	-.19428	-.08480	.52500
4.30	.04501	.03900	.14168	-.18518	-.09679	.53750
4.40	.04824	.02574	.12366	-.17501	-.10612	.55000
4.50	.05022	.01423	.10670	-.16404	-.11300	.56250
4.60	.05113	.00436	.09087	-.15240	-.11761	.57500
4.70	.05114	-.00398	.07621	-.14050	-.12018	.58750
4.80	.05038	-.01092	.06275	-.12852	-.12092	.60000
4.90	.04899	-.01657	.05050	-.11646	-.12004	.61250
5.00	.04710	-.02106	.03946	-.10456	-.11776	.62500
5.10	.04481	-.02450	.02958	-.09295	-.11428	.63750
5.20	.04223	-.02702	.02085	-.08174	-.10980	.65000
5.30	.03943	-.02872	.01322	-.07102	-.10451	.66250
5.40	.03651	-.02970	.00663	-.06086	-.09858	.67500
5.50	.03351	-.03008	.00103	-.05132	-.09217	.68750
5.60	.03051	-.02994	-.00365	-.04244	-.08543	.70000
5.70	.02754	-.02938	-.00747	-.03424	-.07849	.71250
5.80	.02464	-.02847	-.01052	-.02674	-.07147	.72500
5.90	.02185	-.02730	-.01284	-.01994	-.06447	.73750
6.00	.01919	-.02592	-.01453	-.01384	-.05757	.75000
6.10	.01667	-.02441	-.01563	-.00842	-.05085	.76250
6.20	.01431	-.02281	-.01623	-.00366	-.04436	.77500
6.30	.01211	-.02118	-.01639	.00045	-.03815	.78750
6.40	.01007	-.01955	-.01616	.00397	-.03223	.80000
6.50	.00819	-.01796	-.01561	.00691	-.02664	.81250
6.60	.00647	-.01644	-.01479	.00931	-.02138	.82500
6.70	.00490	-.01501	-.01376	.01120	-.01644	.83750
6.80	.00347	-.01369	-.01257	.01261	-.01161	.85000
6.90	.00216	-.01250	-.01125	.01357	-.00747	.86250
7.00	.00096	-.01144	-.00987	.01411	-.00339	.87500
7.10	-.00012	-.01052	-.00844	.01426	.00045	.88750
7.20	-.00114	-.00975	-.00703	.01403	.00410	.90000
7.30	-.00208	-.00911	-.00565	.01344	.00760	.91250
7.40	-.00296	-.00862	-.00435	.01251	.01098	.92500
7.50	-.00381	-.00824	-.00315	.01125	.01428	.93750
7.60	-.00462	-.00798	-.00211	.00966	.01755	.95000
7.70	-.00541	-.00781	-.00123	.00774	.02082	.96250
7.80	-.00618	-.00772	-.00057	.00549	.02412	.97500
7.90	-.00695	-.00769	-.00014	.00291	.02748	.98750
8.00	-.00772	-.00768	.00000	.00000	.03090	1.00000

TABLE 49. COEFFICIENTS FOR PILE WITH NEGATIVE MOMENT AT GROUND SURFACE

J = .00 R = 1.35 T = 3.875

βx	C_y	C_S	C_M	C_V	C_q	$K/K_{8.0}$
.00	-2.35258	.00000	-1.34951	1.00000	-.00000	-.00000
.10	-2.34599	.12984	-1.24952	.99985	.00406	.00043
.20	-2.32692	.24980	-1.14957	.99890	.01606	.00172
.30	-2.29635	.35976	-1.04978	.99637	.03550	.00386
.40	-2.25528	.45977	-.95036	.99156	.06169	.00683
.50	-2.20470	.54986	-.85156	.98383	.09377	.01063
.60	-2.14561	.63011	-.75370	.97263	.13077	.01523
.70	-2.07898	.70065	-.65716	.95754	.17160	.02063
.80	-2.00578	.76161	-.56233	.93821	.21513	.02681
.90	-1.92695	.81319	-.46965	.91445	.26021	.03376
1.00	-1.84343	.85563	-.37958	.88616	.30570	.04145
1.10	-1.75610	.88921	-.29256	.85334	.35046	.04989
1.20	-1.66585	.91427	-.20905	.81613	.39346	.05904
1.30	-1.57350	.93116	-.12947	.77474	.43371	.06890
1.40	-1.47986	.94031	-.05422	.72951	.47034	.07945
1.50	-1.38567	.94218	.01632	.68083	.50259	.09067
1.60	-1.29164	.93723	.08184	.62917	.52982	.10254
1.70	-1.19842	.92599	.14208	.57506	.55153	.11505
1.80	-1.10662	.90901	.19680	.51907	.56736	.12817
1.90	-1.01678	.88683	.24585	.46180	.57707	.14188
2.00	-.92939	.86004	.28914	.40388	.58059	.15617
2.10	-.84490	.82921	.32663	.34591	.57794	.17100
2.20	-.76366	.79492	.35834	.28850	.56929	.18636
2.30	-.68600	.75774	.38436	.23225	.55492	.20222
2.40	-.61218	.71824	.40484	.17771	.53520	.21856
2.50	-.54241	.67696	.41998	.12538	.51060	.23534
2.60	-.47683	.63442	.43000	.07574	.48165	.25253
2.70	-.41555	.59113	.43522	.02871	.44896	.27010
2.80	-.35861	.54754	.43595	-.01393	.41314	.28801
2.90	-.30603	.50408	.43255	-.05338	.37486	.30622
3.00	-.25778	.46116	.42540	-.08884	.33480	.32469
3.10	-.21377	.41912	.41491	-.12027	.29362	.34337
3.20	-.17391	.37828	.40148	-.14755	.25197	.36220
3.30	-.13807	.33891	.38553	-.17067	.21048	.38110
3.40	-.10608	.30125	.36747	-.18968	.16973	.40001
3.50	-.07776	.26548	.34771	-.20466	.13027	.41880
3.60	-.05292	.23175	.32666	-.21579	.09258	.43734
3.70	-.03134	.20018	.30467	-.22326	.05710	.45543
3.80	-.01281	.17084	.28211	-.22731	.02423	.47268
3.90	.00289	.14377	.25931	-.22821	-.00564	.48750
4.00	.01600	.11895	.23656	-.22633	-.03201	.50000

TABLE 49. (CONTD.) COEFFICIENTS FOR PILE WITH NEGATIVE MOMENT AT GROUND SURFACE

J = .00 R = 1.35 T = 3.875

βx	C_y	C_S	C_M	C_V	C_q	$K/K_{8.0}$
4.00	.01600	.11895	.23656	-.22633	-.03201	.50000
4.10	.02675	.09644	.21412	-.22193	-.05485	.51250
4.20	.03536	.07613	.19223	-.21545	-.07427	.52500
4.30	.04205	.05797	.17109	-.20719	-.09041	.53750
4.40	.04702	.04188	.15084	-.19748	-.10346	.55000
4.50	.05049	.02776	.13163	-.18660	-.11360	.56250
4.60	.05263	.01551	.11355	-.17485	-.12106	.57500
4.70	.05364	.00501	.09667	-.16248	-.12607	.58750
4.80	.05369	-.00386	.08106	-.14971	-.12886	.60000
4.90	.05292	-.01124	.06674	-.13678	-.12966	.61250
5.00	.05148	-.01725	.05370	-.12384	-.12871	.62500
5.10	.04951	-.02203	.04196	-.11109	-.12625	.63750
5.20	.04711	-.02569	.03148	-.09864	-.12249	.65000
5.30	.04440	-.02837	.02222	-.08662	-.11766	.66250
5.40	.04146	-.03018	.01413	-.07514	-.11196	.67500
5.50	.03838	-.03123	.00717	-.06426	-.10557	.68750
5.60	.03523	-.03165	.00126	-.05404	-.09867	.70000
5.70	.03207	-.03152	-.00365	-.04453	-.09141	.71250
5.80	.02894	-.03095	-.00766	-.03577	-.08394	.72500
5.90	.02589	-.03002	-.01083	-.02775	-.07639	.73750
6.00	.02295	-.02881	-.01323	-.02049	-.06885	.75000
6.10	.02013	-.02740	-.01495	-.01397	-.06142	.76250
6.20	.01747	-.02584	-.01605	-.00819	-.05417	.77500
6.30	.01497	-.02420	-.01661	-.00313	-.04716	.78750
6.40	.01263	-.02253	-.01670	.00124	-.04043	.80000
6.50	.01046	-.02088	-.01638	.00496	-.03400	.81250
6.60	.00845	-.01927	-.01573	.00805	-.02790	.82500
6.70	.00660	-.01774	-.01479	.01055	-.02213	.83750
6.80	.00490	-.01632	-.01363	.01249	-.01667	.85000
6.90	.00333	-.01502	-.01231	.01390	-.01152	.86250
7.00	.00189	-.01386	-.01087	.01480	-.00663	.87500
7.10	.00056	-.01285	-.00936	.01523	-.00199	.88750
7.20	-.00067	-.01199	-.00784	.01521	.00244	.90000
7.30	-.00184	-.01128	-.00633	.01475	.00671	.91250
7.40	-.00293	-.01072	-.00490	.01387	.01087	.92500
7.50	-.00398	-.01029	-.00357	.01258	.01495	.93750
7.60	-.00500	-.01000	-.00239	.01088	.01901	.95000
7.70	-.00599	-.00981	-.00141	.00878	.02307	.96250
7.80	-.00696	-.00970	-.00065	.00626	.02717	.97500
7.90	-.00793	-.00967	-.00017	.00334	.03134	.98750
8.00	-.00890	-.00966	.00000	.00000	.03561	1.00000

TABLE 50. COEFFICIENTS FOR PILE WITH NEGATIVE MOMENT AT GROUND SURFACE

J = .00 R = 1.05 T = 4.000

βx	C_y	C_S	C_M	C_V	C_q	$K/K_{8.0}$
.00	-2.61052	.00000	-1.40240	1.00000	-.00000	-.00000
.10	-2.60368	.13513	-1.30241	.99987	.00341	.00032
.20	-2.58381	.26037	-1.20245	.99907	.01354	.00131
.30	-2.55191	.37563	-1.10263	.99694	.03008	.00294
.40	-2.50899	.48091	-1.00312	.99285	.05255	.00523
.50	-2.45604	.57627	-.90414	.98624	.08032	.00817
.60	-2.39405	.66177	-.80597	.97662	.11267	.01176
.70	-2.32399	.73751	-.70892	.96357	.14876	.01600
.80	-2.24685	.80361	-.61337	.94676	.18772	.02088
.90	-2.16356	.86025	-.51970	.92596	.22861	.02641
1.00	-2.07508	.90763	-.42831	.90101	.27049	.03258
1.10	-1.98232	.94601	-.33963	.87186	.31243	.03940
1.20	-1.88615	.97567	-.25407	.83856	.35351	.04685
1.30	-1.78745	.99695	-.17204	.80122	.39286	.05494
1.40	-1.68701	1.01021	-.09394	.76007	.42967	.06367
1.50	-1.58564	1.01589	-.02014	.71540	.46322	.07303
1.60	-1.48406	1.01441	.04903	.66756	.49286	.08302
1.70	-1.38297	1.00625	.11328	.61698	.51804	.09364
1.80	-1.28300	.99193	.17235	.56413	.53832	.10489
1.90	-1.18476	.97197	.22605	.50950	.55335	.11676
2.00	-1.08877	.94692	.27422	.45365	.56292	.12925
2.10	-.99551	.91733	.31676	.39711	.56692	.14236
2.20	-.90542	.88377	.35364	.34046	.56532	.15609
2.30	-.81887	.84680	.38487	.28424	.55823	.17042
2.40	-.73615	.80699	.41052	.22900	.54585	.18537
2.50	-.65754	.76489	.43071	.17525	.52845	.20092
2.60	-.09495	.72103	.44563	.12347	.08244	.21706
2.70	-.51337	.67594	.45549	.07412	.48012	.23380
2.80	-.44806	.63010	.46054	.02758	.45009	.25113
2.90	-.38736	.58399	.46110	-.01578	.41686	.26904
3.00	-.33126	.53803	.45750	-.05569	.38098	.28752
3.10	-.27973	.49262	.45008	-.09190	.34304	.30657
3.20	-.23270	.44813	.43924	-.12424	.30362	.32618
3.30	-.19007	.40488	.42536	-.15259	.26331	.34633
3.40	-.15168	.36315	.40884	-.17690	.22268	.36701
3.50	-.11738	.32319	.39010	-.19714	.18227	.38821
3.60	-.08698	.28520	.36954	-.21338	.14261	.40989
3.70	-.06027	.24933	.34755	-.22571	.10416	.43202
3.80	-.03704	.21572	.32451	-.23427	.06735	.45455
3.90	-.01705	.18445	.30081	-.23925	.03257	.47736
4.00	-.00007	.15555	.27677	-.24090	.00015	.50000

TABLE 50. (CONTD.) COEFFICIENTS FOR PILE WITH NEGATIVE MOMENT AT GROUND SURFACE

J = .00 R = 1.05 T = 4.000

βx	C_y	C_S	C_M	C_V	C_q	$K/K_{8.0}$
4.00	-.00007	.15555	.27677	-.24090	.00015	.50000
4.10	.01413	.12910	.25273	-.23940	-.02897	.51250
4.20	.02581	.10502	.22897	-.23521	-.05421	.52500
4.30	.03521	.08328	.20576	-.22869	-.07570	.53750
4.40	.04254	.06384	.18330	-.22019	-.09360	.55000
4.50	.04804	.04659	.16177	-.21009	-.10811	.56250
4.60	.05193	.03144	.14132	-.19869	-.11944	.57500
4.70	.05440	.01828	.12206	-.18630	-.12784	.58750
4.80	.05564	.00699	.10408	-.17321	-.13355	.60000
4.90	.05585	-.00257	.08743	-.15968	-.13683	.61250
5.00	.05518	-.01054	.07215	-.14592	-.13795	.62500
5.10	.05378	-.01705	.05825	-.13215	-.13716	.63750
5.20	.05181	-.02224	.04571	-.11855	-.13471	.65000
5.30	.04937	-.02624	.03453	-.10526	-.13085	.66250
5.40	.04659	-.02919	.02465	-.09242	-.12580	.67500
5.50	.04356	-.03122	.01603	-.08013	-.11980	.68750
5.60	.04037	-.03244	.00860	-.06848	-.11305	.70000
5.70	.03709	-.03298	.00231	-.05754	-.10573	.71250
5.80	.03379	-.03294	-.00292	-.04735	-.09801	.72500
5.90	.03052	-.03243	-.00718	-.03795	-.09004	.73750
6.00	.02732	-.03154	-.01054	-.02935	-.08197	.75000
6.10	.02422	-.03035	-.01308	-.02155	-.07389	.76250
6.20	.02125	-.02895	-.01487	-.01456	-.06590	.77500
6.30	.01844	-.02740	-.01601	-.00837	-.05808	.78750
6.40	.01578	-.02576	-.01657	-.00294	-.05050	.80000
6.50	.01328	-.02410	-.01663	.00173	-.04318	.81250
6.60	.01096	-.02245	-.01625	.00570	-.03617	.82500
6.70	.00879	-.02086	-.01551	.00898	-.02946	.83750
6.80	.00678	-.01936	-.01447	.01160	-.02307	.85000
6.90	.00491	-.01797	-.01320	.01360	-.01697	.86250
7.00	.00318	-.01672	-.01177	.01501	-.01114	.87500
7.10	.00156	-.01562	-.01022	.01584	-.00557	.88750
7.20	.00005	-.01468	-.00861	.01613	-.00019	.90000
7.30	-.00137	-.01390	-.00701	.01589	.00501	.91250
7.40	-.00273	-.01328	-.00545	.01513	.01010	.92500
7.50	-.00403	-.01280	-.00400	.01387	.01512	.93750
7.60	-.00529	-.01247	-.00269	.01211	.02012	.95000
7.70	-.00653	-.01226	-.00159	.00984	.02515	.96250
7.80	-.00775	-.01214	-.00074	.00708	.03023	.97500
7.90	-.00896	-.01210	-.00019	.00379	.03540	.98750
8.00	-.01017	-.01209	.00000	.00000	.04069	1.00000

APPENDIX L

RESULTS FOR PILES WITH J = -0.40

TABLE 51. COEFFICIENTS FOR PILE WITH NEGATIVE MOMENT AT GROUND SURFACE

J = -.40 K = (X/8.0)K

βX	C_y	C_S	C_M	C_V	C_q	$K/K_{8.0}$
.00	-1.78463	.35517	-.88792	1.00000	.00000	.00000
.10	-1.74484	.43886	-.78807	.99551	.08724	.01250
.20	-1.69717	.51271	-.68908	.98262	.16971	.02500
.30	-1.64261	.57674	-.59179	.96177	.24639	.03750
.40	-1.58212	.63115	-.49696	.93358	.31642	.05000
.50	-1.51667	.67624	-.40528	.89874	.37916	.06250
.60	-1.44716	.71235	-.31739	.85802	.43414	.07500
.70	-1.37447	.73987	-.23384	.81220	.48106	.08750
.80	-1.29943	.75928	-.15509	.76210	.51977	.10000
.90	-1.22285	.77108	-.08152	.70854	.55028	.11250
1.00	-1.14544	.77578	-.01346	.65233	.57272	.12500
1.10	-1.06789	.77397	.04887	.59427	.58734	.13750
1.20	-.99083	.76622	.10535	.53512	.59450	.15000
1.30	-.91482	.75311	.15589	.47562	.59463	.16250
1.40	-.84035	.73525	.20049	.41643	.58825	.17500
1.50	-.76789	.71322	.23920	.35818	.57592	.18750
1.60	-.69782	.68761	.27217	.30143	.55826	.20000
1.70	-.63047	.65898	.29955	.24669	.53590	.21250
1.80	-.56610	.62789	.32158	.19440	.50949	.22500
1.90	-.50495	.59485	.33852	.14491	.47970	.23750
2.00	-.44718	.56035	.35067	.09855	.44718	.25000
2.10	-.39291	.52487	.35834	.05555	.41255	.26250
2.20	-.34222	.48883	.36189	.01609	.37644	.27500
2.30	-.29515	.45262	.36167	-.01970	.33942	.28750
2.40	-.25169	.41661	.35806	-.05177	.30203	.30000
2.50	-.21181	.38112	.35144	-.08011	.26476	.31250
2.60	-.17544	.34642	.34216	-.10474	.22807	.32500
2.70	-.14249	.31277	.33060	-.12574	.19236	.33750
2.80	-.11284	.28037	.31712	-.14326	.15798	.35000
2.90	-.08637	.24940	.30205	-.15741	.12524	.36250
3.00	-.06291	.22000	.28573	-.16838	.09437	.37500
3.10	-.04232	.19228	.26847	-.17636	.06559	.38750
3.20	-.02440	.16633	.25054	-.18158	.03905	.40000
3.30	-.00899	.14219	.23223	-.18425	.01484	.41250
3.40	.00409	.11989	.21376	-.18463	-.00695	.42500
3.50	.01503	.09943	.19537	-.18295	-.02631	.43750
3.60	.02403	.08080	.17723	-.17945	-.04326	.45000
3.70	.03125	.06397	.15952	-.17438	-.05782	.46250
3.80	.03688	.04888	.14239	-.16797	-.07008	.47500
3.90	.04108	.03547	.12596	-.16044	-.08011	.48750
4.00	.04402	.02364	.11033	-.15203	-.08805	.50000

TABLE 52. COEFFICIENTS FOR PILE WITH NEGATIVE MOMENT AT GROUND SURFACE

J = -.40 R = 5.00 T = 3.400

βx	C_y	C_S	C_M	C_V	C_q	$K/K_{8.0}$
.00	-2.05555	.38976	-.97441	1.00000	-.00000	-.00000
.10	-2.01186	.48210	-.87442	.99949	.01394	.00173
.20	-1.95944	.56455	-.77460	.99638	.05123	.00653
.30	-1.89927	.63704	-.67529	.98865	.10537	.01387
.40	-1.83234	.69965	-.57705	.97492	.17047	.02325
.50	-1.75964	.75251	-.48052	.95435	.24131	.03428
.60	-1.68213	.79584	-.38641	.92661	.31348	.04659
.70	-1.60076	.82990	-.29542	.89174	.38333	.05986
.80	-1.51643	.85506	-.20827	.85013	.44795	.07384
.90	-1.43001	.87172	-.12559	.80241	.50519	.08831
1.00	-1.34234	.88036	-.04795	.74940	.55354	.10309
1.10	-1.25418	.88150	.02415	.69205	.59208	.11802
1.20	-1.16625	.87573	.09034	.63135	.62038	.13298
1.30	-1.07923	.86365	.15034	.56833	.63844	.14789
1.40	-.99370	.84589	.20397	.50401	.64660	.16267
1.50	-.91020	.82309	.25114	.43934	.64545	.17728
1.60	-.82922	.79589	.29186	.37522	.63578	.19168
1.70	-.75114	.76494	.32622	.31245	.61852	.20585
1.80	-.67633	.73086	.35441	.25175	.59465	.21980
1.90	-.60505	.69427	.37666	.19372	.56519	.23353
2.00	-.53753	.65573	.39326	.13887	.53117	.24704
2.10	-.47394	.61580	.40455	.08764	.49358	.26035
2.20	-.41440	.57499	.41090	.04025	.45334	.27349
2.30	-.35896	.53378	.41273	-.00298	.41134	.28648
2.40	-.30764	.49259	.41044	-.04197	.36836	.29933
2.50	-.26042	.45182	.40447	-.07665	.32511	.31209
2.60	-.21725	.41181	.39524	-.10701	.28222	.32476
2.70	-.17803	.37287	.38320	-.13312	.24025	.33737
2.80	-.14263	.33526	.36875	-.15811	.19966	.34994
2.90	-.11093	.29919	.35230	-.17312	.16083	.36247
3.00	-.08274	.26486	.33424	-.18735	.12411	.37499
3.10	-.05790	.23239	.31494	-.19803	.08974	.38749
3.20	-.03620	.20190	.29474	-.20539	.05792	.39999
3.30	-.01745	.17346	.27395	-.20971	.02880	.41250
3.40	-.00144	.14712	.25288	-.21125	.00245	.42500
3.50	.01203	.12289	.23178	-.21030	-.02106	.43750
3.60	.02319	.10075	.21089	-.20714	-.04175	.45000
3.70	.03225	.08069	.19041	-.20205	-.05966	.46250
3.80	.03940	.06265	.17053	-.19530	-.07486	.47500
3.90	.04484	.04656	.15140	-.18717	-.08744	.48750
4.00	.04877	.03232	.13313	-.17791	-.09754	.50000

TABLE 53. COEFFICIENTS FOR PILE WITH NEGATIVE MOMENT AT GROUND SURFACE

J = -.40 R = 2.75 T = 3.500

βx	C_y	C_S	C_M	C_V	C_q	$K/K_{8.0}$
.00	-2.33918	.41702	-1.04257	1.00000	-.00000	-.00000
.10	-2.29243	.51618	-.94257	.99968	.00878	.00095
.20	-2.23625	.60544	-.84268	.99768	.03340	.00373
.30	-2.17165	.68473	-.74314	.99253	.07114	.00819
.40	-2.09962	.75409	-.64431	.98308	.11915	.01418
.50	-2.02114	.81363	-.54668	.96844	.17458	.02159
.60	-1.93719	.86349	-.45080	.94800	.23465	.03028
.70	-1.84874	.90388	-.35727	.92144	.29675	.04012
.80	-1.75671	.93505	-.26671	.88866	.35847	.05101
.90	-1.66200	.95734	-.17973	.84983	.41765	.06282
1.00	-1.56550	.97115	-.09692	.80529	.47245	.07544
1.10	-1.46803	.97690	-.01883	.75555	.52133	.08878
1.20	-1.37036	.97510	.05404	.70127	.56306	.10272
1.30	-1.27322	.96629	.12130	.64322	.59676	.11717
1.40	-1.17730	.95105	.18259	.58223	.62185	.13205
1.50	-1.08320	.92999	.23768	.51917	.63805	.14726
1.60	-.99146	.90374	.28639	.45493	.64534	.16272
1.70	-.90259	.87294	.32866	.39040	.64397	.17836
1.80	-.81700	.83823	.36449	.32643	.63437	.19411
1.90	-.73505	.80026	.39398	.26380	.61716	.20990
2.00	-.65703	.75966	.41731	.20324	.59311	.22567
2.10	-.58318	.71701	.43472	.14539	.56306	.24137
2.20	-.51367	.67291	.44650	.09080	.52795	.25694
2.30	-.44862	.62789	.45300	.03994	.48874	.27235
2.40	-.38810	.58248	.45461	-.00683	.44641	.28756
2.50	-.33212	.53713	.45177	-.04925	.40191	.30253
2.60	-.28066	.49227	.44490	-.08716	.35615	.31723
2.70	-.23364	.44827	.43448	-.12047	.30997	.33167
2.80	-.19097	.40548	.42095	-.14917	.26416	.34581
2.90	-.15250	.36418	.40478	-.17334	.21939	.35966
3.00	-.11808	.32460	.38642	-.19311	.17628	.37322
3.10	-.08752	.28695	.36629	-.20867	.13531	.38650
3.20	-.06062	.25139	.34481	-.22026	.09688	.39953
3.30	-.03717	.21803	.32235	-.22815	.06131	.41234
3.40	-.01694	.18694	.29928	-.23263	.02880	.42497
3.50	.00028	.15818	.27592	-.23403	-.00050	.43750
3.60	.01476	.13175	.25256	-.23265	-.02657	.45000
3.70	.02671	.10766	.22947	-.22882	-.04941	.46250
3.80	.03636	.08584	.20686	-.22288	-.06909	.47500
3.90	.04395	.06626	.18495	-.21511	-.08570	.48750
4.00	.04968	.04880	.16389	-.20585	-.09937	.50000

TABLE 54. COEFFICIENTS FOR PILE WITH NEGATIVE MOMENT AT GROUND SURFACE

J = -.40 R = 1.80 T = 3.625

βx	C_y	C_S	C_M	C_V	C_q	$K/K_{8.0}$
.00	-2.65411	.44294	-1.10737	1.00000	-.00000	-.00000
.10	-2.60444	.54858	-1.00737	.99977	.00639	.00061
.20	-2.54470	.64432	-.90745	.99829	.02471	.00242
.30	-2.47589	.73008	-.80779	.99445	.05348	.00540
.40	-2.39900	.80589	-.70866	.98729	.09106	.00948
.50	-2.31502	.87185	-.61046	.97599	.13568	.01465
.60	-2.22493	.92803	-.51361	.95996	.18554	.02084
.70	-2.12971	.97463	-.41863	.93876	.23880	.02803
.80	-2.03030	1.01184	-.32603	.91214	.29368	.03616
.90	-1.92763	1.03994	-.23637	.88003	.34846	.04519
1.00	-1.82259	1.05925	-.15019	.84251	.40156	.05508
1.10	-1.71604	1.07012	-.06803	.79983	.45154	.06578
1.20	-1.60881	1.07301	.00962	.75236	.49713	.07725
1.30	-1.50167	1.06837	.08230	.70059	.53725	.08944
1.40	-1.39535	1.05674	.14962	.64513	.57103	.10230
1.50	-1.29053	1.03866	.21123	.58664	.59779	.11580
1.60	-1.18781	1.01470	.26688	.52584	.61709	.12988
1.70	-1.08775	.98549	.31635	.46349	.62867	.14448
1.80	-.99085	.95165	.35955	.40038	.63248	.15958
1.90	-.89754	.91381	.39643	.33726	.62867	.17510
2.00	-.80819	.87259	.42703	.27490	.61752	.19101
2.10	-.72311	.82862	.45146	.21400	.59948	.20725
2.20	-.64254	.78251	.46990	.15523	.57515	.22377
2.30	-.56666	.73484	.48259	.09917	.54518	.24052
2.40	-.49560	.68618	.48983	.04636	.51035	.25743
2.50	-.42943	.63706	.49198	-.00274	.47146	.27446
2.60	-.36819	.58795	.48941	-.04781	.42938	.29154
2.70	-.31183	.53932	.48255	-.08854	.38495	.30862
2.80	-.26129	.49157	.47184	-.12474	.33903	.32562
2.90	-.21347	.44507	.45775	-.15632	.29246	.34249
3.00	-.17123	.40013	.44072	-.18324	.24599	.35915
3.10	-.13339	.35701	.42124	-.20555	.20037	.37553
3.20	-.09976	.31595	.39975	-.22337	.15625	.39155
3.30	-.07013	.27712	.37670	-.23688	.11421	.40712
3.40	-.04426	.24065	.35250	-.24630	.07474	.42214
3.50	-.02192	.20664	.32756	-.25193	.03828	.43647
3.60	-.00285	.17515	.30223	-.25408	.00514	.44994
3.70	.01318	.14620	.27684	-.25309	-.02439	.46250
3.80	.02645	.11977	.25169	-.24933	-.05027	.47500
3.90	.03721	.09584	.22705	-.24316	-.07257	.48750
4.00	.04570	.07431	.20312	-.23496	-.09140	.50000

TABLE 55. COEFFICIENTS FOR PILE WITH NEGATIVE MOMENT AT GROUND SURFACE

J = -.40 R = 1.35 T = 3.725

βx	C_y	C_S	C_M	C_V	C_q	$K/K_{8.0}$
.00	-2.93275	.46349	-1.15873	1.00000	-.00000	-.00000
.10	-2.88077	.57426	-1.05873	.99981	.00519	.00045
.20	-2.81821	.67514	-.95880	.99861	.02023	.00179
.30	-2.74606	.76603	-.85907	.99545	.04414	.00401
.40	-2.66531	.84697	-.75980	.98950	.07578	.00710
.50	-2.57697	.91802	-.66128	.98006	.11391	.01105
.60	-2.48202	.97926	-.56391	.96654	.15717	.01583
.70	-2.38142	1.03085	-.46811	.94840	.20419	.02143
.80	-2.27614	1.07296	-.37436	.92562	.25354	.02784
.90	-2.16712	1.10582	-.28315	.89775	.30355	.03505
1.00	-2.05526	1.12970	-.19407	.86486	.35378	.04303
1.10	-1.94145	1.14494	-.11033	.82705	.40217	.05177
1.20	-1.82653	1.15191	-.02970	.78455	.44756	.06125
1.30	-1.71131	1.15103	.04644	.73767	.48921	.07146
1.40	-1.59655	1.14279	.11770	.68687	.52611	.08238
1.50	-1.48297	1.12769	.18370	.63265	.55751	.09398
1.60	-1.37121	1.10625	.24414	.57558	.58279	.10625
1.70	-1.26190	1.07906	.29875	.51632	.60153	.11917
1.80	-1.15556	1.04671	.34736	.45552	.61343	.13271
1.90	-1.05270	1.00980	.38983	.39388	.61837	.14685
2.00	-.95372	.96896	.42613	.33209	.61638	.16157
2.10	-.85901	.92479	.45627	.27084	.60764	.17684
2.20	-.76885	.87792	.48034	.21079	.59244	.19263
2.30	-.68349	.82894	.49848	.15257	.57120	.20892
2.40	-.60311	.77842	.51093	.09675	.54444	.22568
2.50	-.52783	.72695	.51793	.04385	.51277	.24286
2.60	-.45773	.67502	.51980	-.00565	.47686	.26044
2.70	-.39283	.62315	.51691	-.05139	.43742	.27838
2.80	-.33308	.57179	.50965	-.09304	.39521	.29662
2.90	-.27844	.52136	.49844	-.13036	.35098	.31513
3.00	-.22877	.47223	.48372	-.16319	.30549	.33384
3.10	-.18394	.42472	.46595	-.19144	.25950	.35269
3.20	-.14377	.37913	.44558	-.21510	.21370	.37160
3.30	-.10805	.33568	.42307	-.23421	.16877	.39048
3.40	-.07656	.29457	.39887	-.24890	.12531	.40920
3.50	-.04905	.25595	.37342	-.25935	.08391	.42760
3.60	-.02528	.21992	.34713	-.26578	.04505	.44539
3.70	-.00499	.18654	.32038	-.26847	.00922	.46196
3.80	.01210	.15584	.29354	-.26775	-.02299	.47500
3.90	.02626	.12782	.26692	-.26401	-.05120	.48750
4.00	.03775	.10241	.24082	-.25767	-.07550	.50000

TABLE 56. COEFFICIENTS FOR PILE WITH NEGATIVE MOMENT AT GROUND SURFACE

J = -.40 R = 1.05 T = 3.850

βy	C_y	C_S	C_M	C_V	C_q	$K/K_{8.0}$
.00	-3.23666	.48401	-1.21003	1.00000	-.00000	-.00000
.10	-3.18238	.59991	-1.11003	.99984	.00433	.00034
.20	-3.11699	.70591	-1.01008	.99883	.01697	.00136
.30	-3.04151	.80193	-.91031	.99617	.03725	.00306
.40	-2.95692	.88799	-.81092	.99114	.06434	.00543
.50	-2.86422	.96414	-.71218	.98310	.09731	.00849
.60	-2.76440	1.03046	-.61441	.97151	.13514	.01222
.70	-2.65843	1.08707	-.51800	.95593	.17677	.01662
.80	-2.54728	1.13412	-.42336	.93606	.22106	.02169
.90	-2.43190	1.17182	-.33093	.91167	.26691	.02743
1.00	-2.31320	1.20041	-.24117	.88266	.31319	.03384
1.10	-2.19209	1.22017	-.15454	.84905	.35883	.04092
1.20	-2.06943	1.23144	-.07150	.81095	.40282	.04866
1.30	-1.94605	1.23461	.00751	.76858	.44420	.05706
1.40	-1.82275	1.23010	.08208	.72223	.48211	.06612
1.50	-1.70026	1.21837	.15184	.67230	.51580	.07584
1.60	-1.57929	1.19991	.21645	.61924	.54462	.08621
1.70	-1.46047	1.17527	.27561	.56357	.56805	.09723
1.80	-1.34441	1.14499	.32909	.50584	.58568	.10891
1.90	-1.23163	1.10965	.37673	.44665	.59724	.12123
2.00	-1.12262	1.06986	.41840	.38661	.60258	.13419
2.10	-1.01778	1.02619	.45405	.32635	.60169	.14779
2.20	-.91748	.97926	.48368	.26649	.59464	.16203
2.30	-.82201	.92966	.50738	.20763	.58166	.17690
2.40	-.73161	.87798	.52526	.15036	.56304	.19239
2.50	-.64646	.82481	.53752	.09521	.53919	.20851
2.60	-.56668	.77067	.54438	.04269	.51058	.22525
2.70	-.49234	.71611	.54615	-.00475	.47776	.24259
2.80	-.42345	.66161	.54314	-.05273	.44132	.26054
2.90	-.36000	.60764	.53572	-.09491	.40190	.27909
3.00	-.30190	.55461	.52429	-.13303	.36014	.29823
3.10	-.24904	.50290	.50925	-.16688	.31672	.31794
3.20	-.20126	.45287	.49105	-.19634	.27228	.33821
3.30	-.15840	.40479	.47012	-.22133	.22749	.35903
3.40	-.12024	.35892	.44692	-.24184	.18294	.38038
3.50	-.08654	.31547	.42189	-.25794	.13923	.40222
3.60	-.05706	.27459	.39546	-.26974	.09689	.42451
3.70	-.03153	.23641	.36807	-.27739	.05641	.44717
3.80	-.00969	.20100	.34011	-.28110	.01822	.47003
3.90	.00874	.16840	.31196	-.28114	-.01706	.48750
4.00	.02407	.13857	.28398	-.27787	-.04814	.50000

APPENDIX M

RESULTS FOR PILES WITH J = -1.00

TABLE 57. COEFFICIENTS FOR PILE WITH NEGATIVE MOMENT AT GROUND SURFACE

J = -1.00   K = (X/8.0)K

βx	C_y	C_S	C_M	C_V	C_q	$K/K_{8.0}$
.00	-2.16328	.71072	-.71072	1.00000	.00000	.00000
.10	-2.08882	.77670	-.61090	.99460	.10444	.01250
.20	-2.00825	.83283	-.51211	.97928	.20082	.02500
.30	-1.92256	.87919	-.41533	.95475	.28838	.03750
.40	-1.83271	.91600	-.32142	.92194	.36654	.05000
.50	-1.73964	.94360	-.23117	.88179	.43491	.06250
.60	-1.64426	.96239	-.14526	.83531	.49327	.07500
.70	-1.54742	.97283	-.06427	.78349	.54159	.08750
.80	-1.44994	.97544	.01129	.72734	.57997	.10000
.90	-1.35256	.97076	.08108	.66784	.60865	.11250
1.00	-1.25599	.95944	.14479	.60594	.62799	.12500
1.10	-1.16086	.94204	.20222	.54258	.63847	.13750
1.20	-1.06775	.91922	.25328	.47854	.64065	.15000
1.30	-.97717	.89161	.29794	.41469	.63516	.16250
1.40	-.88956	.85985	.33625	.35175	.62269	.17500
1.50	-.80530	.82458	.36834	.29038	.60398	.18750
1.60	-.72473	.78640	.39439	.23115	.57978	.20000
1.70	-.64810	.74591	.41465	.17459	.55088	.21250
1.80	-.57560	.70366	.42941	.12111	.51804	.22500
1.90	-.50740	.66021	.43898	.07109	.48203	.23750
2.00	-.44358	.61604	.44374	.02479	.44358	.25000
2.10	-.38420	.57161	.44407	-.01756	.40341	.26250
2.20	-.32925	.52737	.44036	-.05584	.36218	.27500
2.30	-.27871	.48367	.43303	-.08998	.32052	.28750
2.40	-.23249	.44087	.42249	-.11995	.27809	.30000
2.50	-.19050	.39927	.40916	-.14580	.23812	.31250
2.60	-.15259	.35912	.39346	-.16762	.19837	.32500
2.70	-.11862	.32065	.37576	-.18557	.16014	.33750
2.80	-.08840	.28403	.35646	-.19971	.12376	.35000
2.90	-.06175	.24940	.33593	-.21034	.08954	.36250
3.00	-.03845	.21687	.31450	-.21770	.05768	.37500
3.10	-.01831	.18652	.29248	-.22199	.02838	.38750
3.20	-.00108	.15839	.27018	-.22347	.00173	.40000
3.30	.01343	.13248	.24787	-.22243	-.02217	.41250
3.40	.02548	.10880	.22577	-.21914	-.04331	.42500
3.50	.03526	.08731	.20410	-.21387	-.06171	.43750
3.60	.04301	.06796	.18305	-.20689	-.07742	.45000
3.70	.04892	.05068	.16277	-.19847	-.09051	.46250
3.80	.05321	.03538	.14339	-.18888	-.10110	.47500
3.90	.05606	.02196	.12502	-.17834	-.10931	.48750
4.00	.05766	.01032	.10774	-.16710	-.11532	.50000

TABLE 58. COEFFICIENTS FOR PILE WITH NEGATIVE MOMENT AT GROUND SURFACE

J = -1.00 R = 5.00 T = 3.250

βx	C_y	C_S	C_M	C_V	C_q	$K/K_{8.0}$
.00	-2.49605	.78700	-.78700	1.00000	-.00000	-.00000
.10	-2.41358	.86060	-.68702	.99936	.01745	.00180
.20	-2.32424	.92431	-.58723	.99550	.06323	.00680
.30	-2.22903	.97807	-.48809	.98603	.12833	.01439
.40	-2.12893	1.02197	-.39025	.96943	.20498	.02407
.50	-2.02493	1.05620	-.29446	.94486	.28665	.03539
.60	-1.91799	1.08097	-.20153	.91211	.36861	.04796
.70	-1.80902	1.09663	-.11228	.87142	.44488	.06148
.80	-1.69893	1.10358	-.02748	.82340	.51413	.07565
.90	-1.58856	1.10231	.05219	.76894	.57355	.09026
1.00	-1.47871	1.09335	.12613	.70909	.62177	.10512
1.10	-1.37011	1.07730	.19387	.64501	.65808	.12007
1.20	-1.26345	1.05480	.25504	.57790	.68237	.13502
1.30	-1.15933	1.02653	.30940	.50895	.69497	.14986
1.40	-1.05830	.99317	.35681	.43929	.69653	.16454
1.50	-.96083	.95542	.39727	.37000	.68800	.17901
1.60	-.86733	.91396	.43085	.30201	.67046	.19325
1.70	-.77813	.86948	.45774	.23618	.64509	.20725
1.80	-.69351	.82264	.47818	.17323	.61312	.22102
1.90	-.61366	.77406	.49249	.11375	.57577	.23456
2.00	-.53873	.72435	.50105	.05822	.53420	.24789
2.10	-.46881	.67404	.50427	.00701	.48952	.26104
2.20	-.40392	.62366	.50260	-.03960	.44275	.27403
2.30	-.34406	.57368	.49650	-.08149	.39483	.28688
2.40	-.28916	.52450	.48645	-.11856	.34657	.29963
2.50	-.23912	.47651	.47294	-.15082	.29871	.31229
2.60	-.19381	.43002	.45644	-.17834	.25188	.32489
2.70	-.15306	.38531	.43741	-.20125	.20661	.33745
2.80	-.11669	.34261	.41632	-.21973	.16336	.34998
2.90	-.08447	.30210	.39360	-.23400	.12249	.36249
3.00	-.05619	.26393	.36965	-.24432	.08429	.37499
3.10	-.03161	.22820	.34485	-.25097	.04900	.38749
3.20	-.01047	.19498	.31956	-.25423	.01676	.40000
3.30	.00746	.16429	.29410	-.25443	-.01231	.41250
3.40	.02246	.13615	.26876	-.25188	-.03818	.42500
3.50	.03477	.11053	.24379	-.24691	-.06084	.43750
3.60	.04464	.08737	.21944	-.23983	-.08035	.45000
3.70	.05232	.06661	.19588	-.23095	-.09679	.46250
3.80	.05803	.04816	.17330	-.22057	-.11027	.47500
3.90	.06202	.03191	.15181	-.20899	-.12094	.48750
4.00	.06448	.01773	.13153	-.19648	-.12897	.50000

TABLE 59. COEFFICIENTS FOR PILE WITH NEGATIVE MOMENT AT GROUND SURFACE

J = -1.00 R = 2.75 T = 3.350

βx	C_y	C_S	C_M	C_V	C_q	$K/K_{8.0}$
.00	-2.83603	.84826	-.84826	1.00000	-.000[illegible]0	-.00000
.10	-2.74713	.92798	-.74827	.99960	.01098	.00099
.20	-2.65074	.99782	-.64841	.99711	.04128	.00389
.30	-2.54787	1.05768	-.54897	.99080	.08691	.00852
.40	-2.43951	1.10764	-.45041	.97933	.14397	.01475
.50	-2.32665	1.14782	-.35329	.96174	.20873	.02242
.60	-2.21025	1.17837	-.25827	.93743	.27772	.03141
.70	-2.09127	1.19957	-.16602	.90615	.34776	.04157
.80	-1.97062	1.21170	-.07725	.86794	.416[illegible]4	.05278
.90	-1.84920	1.21517	.00735	.82309	.48015	.06491
1.00	-1.72784	1.21041	.08716	.77213	.538[illegible]5	.07785
1.10	-1.60736	1.19792	.16161	.71576	.58817	.09148
1.20	-1.48848	1.17829	.23017	.65481	.62931	.10569
1.30	-1.37190	1.15211	.29246	.59024	.66069	.12039
1.40	-1.25824	1.12003	.34814	.52303	.68189	.13548
1.50	-1.14806	1.08273	.39701	.45422	.69282	.15086
1.60	-1.04184	1.04087	.43897	.38482	.69371	.16646
1.70	-.94000	.99517	.47399	.31582	.685[illegible]4	.18219
1.80	-.84290	.94631	.50217	.24813	.66750	.19797
1.90	-.75082	.89497	.52368	.18260	.64197	.21375
2.00	-.66396	.84181	.53878	.11998	.60943	.22946
2.10	-.58249	.78743	.54779	.06092	.57096	.24505
2.20	-.50650	.73245	.55110	.00596	.52770	.26046
2.30	-.43600	.67740	.54913	-.04448	.48077	.27566
2.40	-.37100	.62279	.54235	-.09010	.43129	.29062
2.50	-.31142	.56908	.53127	-.13068	.38031	.30530
2.60	-.25714	.51667	.51638	-.16614	.32883	.31969
2.70	-.20803	.46592	.49820	-.19646	27776	.33378
2.80	-.16390	.41713	.47724	-.22173	.22766	.34756
2.90	-.12453	.37055	.45400	-.24210	.17985	.36104
3.00	-.08971	.32639	.42896	-.25779	.13430	.37424
3.10	-.05917	.28480	.40258	-.26907	.09165	.38719
3.20	-.03266	.24591	.37528	-.27624	.05226	.39992
3.30	-.00991	.20977	.34745	-.27964	.01635	.41249
3.40	.00937	.17642	.31945	-.27964	-.01593	.42500
3.50	.02546	.14587	.29162	-.27659	-.04455	.43750
3.60	.03863	.11808	.26422	-.27086	-.06954	.45000
3.70	.04916	.09300	.23752	-.26281	-.09095	.46250
3.80	.05731	.20973	.21172	-.25279	-.10890	.47500
3.90	.06335	.05062	.18701	-.24114	-.12353	.48750
4.00	.06751	.03308	.16353	-.22820	-.13503	.50000

TABLE 60. COEFFICIENTS FOR PILE WITH NEGATIVE MOMENT AT GROUND SURFACE

J = -1.00 R = 1.80 T = 3.475

βy	C_y	C_S	C_M	C_V	C_q	$K/K_{8.0}$
.00	-3.21090	.90731	-.90731	1.00000	-.00000	-.00000
.10	-3.11580	.99293	-.80731	.99971	.00797	.00064
.20	-3.01263	1.06867	-.70741	.99788	.03048	.00253
.30	-2.90238	1.13443	-.60783	.99318	.06530	.00562
.40	-2.78605	1.19026	-.50890	.98447	.11009	.00987
.50	-2.66463	1.23625	-.41108	.97089	.16250	.01524
.60	-2.53910	1.27253	-.31489	.95178	.22019	.02167
.70	-2.41042	1.29931	-.22091	.92674	.28059	.02913
.80	-2.27953	1.31682	-.12974	.89557	.34247	.03755
.90	-2.14734	1.32537	-.04199	.85829	.40293	.04691
1.00	-2.01472	1.32536	.04173	.81509	.46046	.05713
1.10	-1.88252	1.31719	.12085	.76635	.51349	.06819
1.20	-1.75152	1.30137	.19484	.71260	.56066	.08002
1.30	-1.62247	1.27842	.26323	.65447	.60087	.09258
1.40	-1.49604	1.24893	.32562	.59270	.63327	.10582
1.50	-1.37287	1.21352	.38168	.52811	.65726	.11968
1.60	-1.25350	1.17283	.43118	.46156	.67251	.13412
1.70	-1.13845	1.12752	.47396	.39392	.67889	.14908
1.80	-1.02812	1.07827	.50996	.32609	.67654	.16450
1.90	-.92289	1.02577	.53920	.25891	.66576	.18034
2.00	-.82305	.97067	.56179	.19322	.64704	.19653
2.10	-.72882	.91364	.57792	.12976	.62103	.21302
2.20	-.64036	.85530	.58784	.06924	.58851	.22975
2.30	-.55778	.79628	.59188	.01226	.55035	.24666
2.40	-.48111	.73712	.59042	-.04065	.50747	.26369
2.50	-.41034	.67837	.58389	-.08910	.46086	.28077
2.60	-.34540	.62051	.57275	-.13273	.41152	.29784
2.70	-.28619	.56397	.55750	-.17134	.36042	.31483
2.80	-.23256	.50913	.53864	-.20479	.30853	.33167
2.90	-.18430	.45635	.51670	-.23305	.25676	.34827
3.00	-.14121	.40589	.49219	-.25617	.20593	.36456
3.10	-.10304	.35798	.46562	-.27430	.15682	.38045
3.20	-.06953	.31282	.43748	-.28762	.11010	.39583
3.30	-.04039	.27052	.40824	-.29642	.06634	.41059
3.40	-.01533	.23119	.37833	-.30101	.02604	.42457
3.50	.00593	.19487	.34815	-.30177	-.01039	.43750
3.60	.02373	.16156	.31808	-.29908	-.04271	.45000
3.70	.03834	.13123	.28843	-.29337	-.07093	.46250
3.80	.05007	.10384	.25949	-.28504	-.09513	.47500
3.90	.05920	.07930	.23149	-.27448	-.11544	.48750
4.00	.06601	.05748	.20465	-.26210	-.13203	.50000

TABLE 61. COEFFICIENTS FOR PILE WITH NEGATIVE MOMENT AT GROUND SURFACE

J = -1.00 R = 1.35 T = 3.575

βy	C_y	C_S	C_M	C_V	C_q	$K/K_{8.0}$
.00	-3.54104	.95452	-.95452	1.00000	-.00000	-.00000
.10	-3.44098	1.04487	-.85453	.99976	.00646	.00046
.20	-3.33237	1.12533	-.75461	.99828	.02491	.00186
.30	-3.21622	1.19580	-.65495	.99441	.05383	.00418
.40	-3.09352	1.25634	-.55583	.98720	.09157	.00740
.50	-2.96526	1.30701	-.45764	.97584	.13643	.01150
.60	-2.83243	1.34791	-.36081	.95972	.18665	.01647
.70	-2.69598	1.37923	-.26585	.93838	.24048	.02230
.80	-2.55687	1.40117	-.17330	.91156	.29622	.02896
.90	-2.41603	1.41400	-.08372	.87913	.35222	.03644
1.00	-2.27435	1.41805	.00234	.84116	.40695	.04473
1.10	-2.13268	1.41367	.08434	.79784	.45898	.05380
1.20	-1.99186	1.40133	.16175	.74950	.50704	.06363
1.30	-1.85265	1.38150	.23410	.69661	.55002	.07422
1.40	-1.71577	1.35471	.30095	.63971	.58699	.08552
1.50	-1.58191	1.32153	.36193	.57945	.61719	.09753
1.60	-1.45165	1.28254	.41675	.51653	.64007	.11023
1.70	-1.32556	1.23839	.46518	.45171	.65526	.12358
1.80	-1.20411	1.18973	.50706	.38576	.66258	.13756
1.90	-1.08773	1.13722	.54232	.31947	.66203	.15215
2.00	-.97677	1.08151	.57097	.25362	.65377	.16733
2.10	-.87151	1.02325	.59308	.18897	.63813	.18305
2.20	-.77217	.96311	.60882	.12624	.61556	.19929
2.30	-.67892	.90171	.61841	.06608	.58666	.21602
2.40	-.59185	.83964	.62214	.00911	.55209	.23320
2.50	-.51100	.77748	.62035	-.04415	.51262	.25079
2.60	-.43634	.71575	.61344	-.09326	.46907	.26875
2.70	-.36782	.65495	.60184	-.13785	.42230	.28702
2.80	-.30531	.59553	.58602	-.17764	.37317	.30556
2.90	-.24866	.53788	.56647	-.21243	.32257	.32431
3.00	-.19767	.48235	.54369	-.24213	.27135	.34318
3.10	-.15211	.42923	.51820	-.26671	.22032	.36209
3.20	-.11174	.37878	.49051	-.28623	.17026	.38094
3.30	-.07627	.33119	.46111	-.30083	.12190	.39956
3.40	-.04540	.28660	.43049	-.31070	.07588	.41776
3.50	-.01885	.24512	.39911	-.31611	.03281	.43512
3.60	.00371	.20679	.36740	-.31738	-.00668	.45000
3.70	.02260	.17164	.33575	-.31493	-.04182	.46250
3.80	.03814	.13963	.30451	-.30918	-.07246	.47500
3.90	.05062	.11071	.27400	-.30059	-.09872	.48750
4.00	.06037	.08476	.24447	-.28960	-.12075	.50000

TABLE 62. COEFFICIENTS FOR PILE WITH NEGATIVE MOMENT AT GROUND SURFACE

J = -1.00 R = 1.05 T = 3.700

βx	C_y	C_S	C_M	C_V	C_q	$K/K_{8.0}$
.00	-3.90027	1.00204	-1.00204	1.00000	-.00000	-.00000
.10	-3.79522	1.09714	-.90205	.99980	.00538	.00035
.20	-3.68115	1.18235	-.80211	.99856	.02086	.00141
.30	-3.55906	1.25757	-.70240	.99531	.04535	.00318
.40	-3.42994	1.32285	-.60314	.98921	.07765	.00565
.50	-3.29480	1.37823	-.50467	.97955	.11646	.00883
.60	-3.15460	1.42382	-.40736	.96574	.16045	.01271
.70	-3.01033	1.45976	-.31166	.94733	.20824	.01729
.80	-2.86295	1.48623	-.21805	.92400	.25847	.02257
.90	-2.71338	1.50346	-.12702	.89550	.30979	.02854
1.00	-2.56253	1.51175	-.03909	.86205	.36090	.03521
1.10	-2.41129	1.51141	.04522	.82346	.41057	.04256
1.20	-2.26051	1.50284	.12544	.78003	.45767	.05061
1.30	-2.11097	1.48648	.20109	.73206	.50115	.05935
1.40	-1.96344	1.46280	.27173	.67996	.54011	.06877
1.50	-1.81862	1.43233	.33697	.62422	.57376	.07887
1.60	-1.67717	1.39561	.39648	.56541	.60147	.08965
1.70	-1.53967	1.35324	.44997	.50415	.62273	.10111
1.80	-1.40667	1.30584	.49725	.44111	.63720	.11324
1.90	-1.27864	1.25402	.53816	.37694	.64468	.12604
2.00	-1.15599	1.19844	.57263	.31242	.64511	.13951
2.10	-1.03905	1.13972	.60066	.24818	.63858	.15364
2.20	-.92812	1.07852	.62230	.18494	.62531	.16843
2.30	-.82341	1.01548	.63770	.12335	.60562	.18387
2.40	-.72506	.95120	.64704	.06403	.57995	.19996
2.50	-.63318	.88628	.65059	.00756	.54884	.21669
2.60	-.54781	.82127	.64866	-.04554	.51289	.23406
2.70	-.46891	.75672	.64160	-.09487	.47278	.25205
2.80	-.39643	.69312	.62982	-.13990	.42922	.27067
2.90	-.33025	.63091	.61374	-.18062	.38295	.28989
3.00	-.27019	.57051	.59384	-.21652	.33474	.30972
3.10	-.21608	.51226	.57059	-.24753	.28533	.33012
3.20	-.16766	.45649	.54449	-.27357	.23546	.35109
3.30	-.12469	.40345	.51603	-.29463	.18584	.37259
3.40	-.08688	.35335	.48572	-.31077	.13714	.39460
3.50	-.05392	.30635	.45403	-.32211	.08996	.41706
3.60	-.02551	.26257	.42144	-.32884	.04488	.43984
3.70	-.00131	.22208	.38840	-.33118	.00242	.46250
3.80	.01900	.18489	.35533	-.32946	-.03611	.47500
3.90	.03577	.15100	.32262	-.32413	-.06975	.48750
4.00	.04931	.12031	-.30157	-.31571	-.09862	.50000

APPENDIX N

RESULTS FOR PILES WITH J = -2.00

TABLE 63. COEFFICIENTS FOR PILE WITH NEGATIVE MOMENT AT GROUND SURFACE

J = -2.00 $K = (\beta y/8.0)K_{8.0}$

βy	C_y	C_S	C_M	C_V	C_q	$K/K_{8.0}$
.00	-2.54233	1.06666	-.53333	1.00000	.00000	.00000
.10	-2.43316	1.11490	-.43354	.99370	.12165	.01250
.20	-2.31966	1.15331	-.33495	.97593	.23196	.02500
.30	-2.20281	1.18197	-.23867	.94773	.33042	.03750
.40	-2.08356	1.20116	-.14569	.91028	.41671	.05000
.50	-1.96286	1.21126	-.05687	.86482	.49071	.06250
.60	-1.84158	1.21271	.02705	.81257	.55247	.07500
.70	-1.72057	1.20604	.10546	.75475	.60220	.08750
.80	-1.60061	1.19183	.17786	.69254	.64024	.10000
.90	-1.48242	1.17069	.24387	.62710	.66709	.11250
1.00	-1.36666	1.14329	.30322	.55950	.68373	.12500
1.10	-1.25393	1.11029	.35574	.49078	.68966	.13750
1.20	-1.14476	1.07239	.40137	.42189	.68685	.15000
1.30	-1.03959	1.03026	.44014	.35371	.67573	.16250
1.40	-.93881	.98460	.47216	.28701	.65717	.17500
1.50	-.84276	.93606	.49741	.22250	.63207	.18750
1.60	-.75167	.88530	.51675	.16079	.60133	.20000
1.70	-.66575	.83292	.52987	.10240	.56588	.21250
1.80	-.58512	.77952	.53735	.04775	.52660	.22500
1.90	-.50986	.72564	.53955	-.00281	.48436	.23750
2.00	-.43999	.67178	.53692	-.04904	.43999	.25000
2.10	-.37548	.61841	.52989	-.09076	.39426	.26250
2.20	-.31628	.56594	.51891	-.12787	.34790	.27500
2.30	-.26225	.51475	.50446	-.16034	.30159	.28750
2.40	-.21327	.46516	.48699	-.18821	.25593	.30000
2.50	-.16916	.41744	.46695	-.21157	.21145	.31250
2.60	-.12972	.37184	.44481	-.23056	.16864	.32500
2.70	-.09472	.32854	.42097	-.24537	.12787	.33750
2.80	-.06393	.28769	.39586	-.25622	.08951	.35000
2.90	-.03710	.24940	.36984	-.26337	.05380	.36250
3.00	-.01397	.21374	.34329	-.26708	.02096	.37500
3.10	.00572	.18075	.31652	-.26766	-.00887	.38750
3.20	.02226	.15043	.28984	-.26542	-.03561	.40000
3.30	.03589	.12277	.26352	-.26065	-.05922	.41250
3.40	.04689	.09771	.23778	-.25368	-.07972	.42500
3.50	.05551	.07518	.21284	-.24482	-.09715	.43750
3.60	.06201	.05510	.18887	-.23436	-.11162	.45000
3.70	.06661	.03737	.16601	-.22259	-.12323	.46250
3.80	.06955	.02186	.14438	-.20980	-.13215	.47500
3.90	.07105	.00844	.12407	-.19625	-.13855	.48750
4.00	.07130	-.00301	.10515	-.18218	-.14261	.50000

TABLE 64. COEFFICIENTS FOR PILE WITH NEGATIVE MOMENT AT GROUND SURFACE

J = -2.00 R = 5.00 T = 3.125

βx	C_y	C_S	C_M	C_V	C_q	$K/K_{8.0}$
.00	-2.94454	1.19163	-.59581	1.00000	-.00000	-.00000
.10	-2.82256	1.24610	-.49583	.99923	.02118	.00187
.20	-2.69563	1.29070	-.39609	.99458	.07590	.00703
.30	-2.56473	1.32535	-.29713	.98328	.15244	.01486
.40	-2.43087	1.35018	-.19970	.96364	.24105	.02479
.50	-2.29500	1.36539	-.10468	.93492	.33380	.03636
.60	-2.15808	1.37123	-.01300	.89698	.42445	.04917
.70	-2.02103	1.36812	.07444	.85028	.50871	.06287
.80	-1.88472	1.35652	.15681	.79567	.58203	.07720
.90	-1.74998	1.33697	.23337	.73431	.64379	.09191
1.00	-1.61756	1.31009	.30350	.66748	.69119	.10682
1.10	-1.48817	1.27651	.36673	.59657	.72497	.12178
1.20	-1.36244	1.23698	.42273	.52297	.74496	.13669
1.30	-1.24094	1.19223	.47129	.44804	.75181	.15146
1.40	-1.12414	1.14299	.51233	.37303	.74657	.16603
1.50	-1.01246	1.09004	.54593	.29911	.73047	.18037
1.60	-.90623	1.03407	.57222	.22727	.70492	.19446
1.70	-.80571	.97583	.59147	.15841	.67135	.20831
1.80	-.71111	.91601	.60402	.09324	.63123	.22191
1.90	-.62254	.85525	.61026	.03234	.58594	.23530
2.00	-.54007	.79418	.61064	-.02382	.53680	.24848
2.10	-.46370	.73332	.60565	-.07492	.48504	.26150
2.20	-.39338	.67321	.59582	-.12077	.43174	.27437
2.30	-.32902	.61431	.58166	-.16125	.37789	.28713
2.40	-.27047	.55701	.56373	-.19636	.32435	.29979
2.50	-.21756	.50168	.54256	-.22616	.27186	.31240
2.60	-.17006	.44860	.51866	-.25079	.22106	.32495
2.70	-.12776	.39802	.49255	-.27045	.17207	.33748
2.80	-.09038	.35015	.46472	-.28538	.12653	.34999
2.90	-.05764	.30512	.43562	-.29586	.08358	.36249
3.00	-.02926	.26306	.40568	-.30221	.04359	.37499
3.10	-.00494	.22400	.37529	-.30477	.00765	.38750
3.20	.01563	.18800	.34483	-.30387	-.02500	.40000
3.30	.03275	.15503	.31461	-.29989	-.05404	.41250
3.40	.04673	.12506	.28494	-.29319	-.07944	.42500
3.50	.05785	.09801	.25605	-.28413	-.10124	.43750
3.60	.06642	.07381	.22817	-.27307	-.11955	.45000
3.70	.07270	.05234	.20149	-.26034	-.13450	.46250
3.80	.07697	.03347	.17615	-.24628	-.14624	.47500
3.90	.07947	.01706	.15226	-.23120	-.15497	.48750
4.00	.08045	.00294	.12993	-.21539	-.16090	.50000

TABLE 65. COEFFICIENTS FOR PILE WITH NEGATIVE MOMENT AT GROUND SURFACE

J = -2.00 R = 2.75 T = 3.225

βx	C_y	C_S	C_M	C_V	C_q	$K/K_{8.0}$
.00	-3.35011	1.29411	-.64706	1.00000	-.00000	-.00000
.10	-3.21763	1.35371	-.54707	.99952	.01334	.00103
.20	-3.07968	1.40343	-.44723	.99652	.04971	.00403
.30	-2.93726	1.44318	-.34791	.98895	.10374	.00883
.40	-2.79135	1.47304	-.24963	.97532	.17039	.01526
.50	-2.64295	1.49318	-.15307	.95459	.24499	.02317
.60	-2.49302	1.50374	-.05895	.92619	.32329	.03241
.70	-2.34249	1.50507	.03193	.88994	.40155	.04285
.80	-2.19228	1.49750	.11879	.84600	.47654	.05434
.90	-2.04326	1.48148	.20090	.79484	.54557	.06675
1.00	-1.89624	1.45753	.27756	.73717	.60648	.07995
1.10	-1.75198	1.42618	.34816	.67380	.65762	.09384
1.20	-1.61121	1.38812	.41219	.60603	.69757	.10829
1.30	-1.47455	1.34399	.46925	.53472	.72656	.12318
1.40	-1.34258	1.29452	.51906	.46114	.74344	.13843
1.50	-1.21579	1.24046	.56145	.38645	.74867	.15394
1.60	-1.09461	1.18250	.59635	.31180	.74272	.16963
1.70	-.97939	1.12143	.62384	.23827	.72633	.18540
1.80	-.87040	1.05799	.64407	.16686	.70067	.20119
1.90	-.76784	.99287	.65731	.09847	.66626	.21692
2.00	-.67185	.92677	.66389	.03386	.62495	.23254
2.10	-.58250	.86031	.66422	-.02631	.57784	.24800
2.20	-.49978	.79412	.65878	-.08155	.52625	.26324
2.30	-.42365	.72874	.64808	-.13145	.47149	.27823
2.40	-.35399	.66467	.63266	-.17578	.41479	.29293
2.50	-.29066	.60236	.61310	-.21439	.35733	.30734
2.60	-.23346	.54216	.58996	-.24726	.30016	.32143
2.70	-.18215	.48447	.56383	-.27446	.24423	.33520
2.80	-.13648	.42950	.53524	-.29618	.19034	.34867
2.90	-.09615	.37749	.50476	-.31263	.13917	.36184
3.00	-.06088	.32860	.47287	-.32413	.09126	.37475
3.10	-.03033	.28295	.44007	-.33101	.04701	.38744
3.20	-.00419	.24060	.40680	-.33367	.00670	.39999
3.30	.01788	.20159	.37346	-.33250	-.02951	.41250
3.40	.03622	.16590	.34041	-.32792	-.06159	.42500
3.50	.05116	.13349	.30797	-.32033	-.08954	.43750
3.60	.06302	.10428	.27642	-.31015	-.11345	.45000
3.70	.07212	.07816	.24601	-.29778	-.13342	.46250
3.80	.07875	.05503	.21692	-.28360	-.14963	.47500
3.90	.08321	.03473	.18933	-.26798	-.16227	.48750
4.00	.08578	.01708	.16336	-.25127	-.17156	.50000

TABLE 66. COEFFICIENTS FOR PILE WITH NEGATIVE MOMENT AT GROUND SURFACE

J = -2.00 R = 1.80 T = 3.350

βy	C_y	C_S	C_M	C_V	C_q	$K/K_{8.0}$
.00	-3.79634	1.39440	-.69720	1.00000	-.00000	-.00000
.10	-3.65358	1.45901	-.59721	.99965	.00969	.00066
.20	-3.50485	1.51374	-.49733	.99745	.03676	.00262
.30	-3.35114	1.55849	-.39783	.99170	.07810	.00582
.40	-3.19346	1.59333	-.29912	.98143	.13066	.01022
.50	-3.03278	1.61838	-.20172	.96537	.19140	.01577
.60	-2.87009	1.63374	-.10624	.94296	.25744	.02242
.70	-2.70633	1.63970	-.01334	.91379	.32604	.03011
.80	-2.54243	1.63653	.07630	.87775	.39467	.03880
.90	-2.37930	1.62458	.16200	.83494	.46103	.04844
1.00	-2.21778	1.60431	.24309	.78560	.52311	.05896
1.10	-2.05868	1.57615	.31895	.73053	.57918	.07033
1.20	-1.90277	1.54071	.38903	.67012	.62780	.08249
1.30	-1.75075	1.49857	.45284	.60527	.66706	.09536
1.40	-1.60325	1.45037	.50997	.53688	.69855	.10892
1.50	-1.46084	1.39683	.56013	.46591	.71936	.12310
1.60	-1.32403	1.33860	.60311	.39336	.73009	.13785
1.70	-1.19324	1.27646	.63879	.32025	.73077	.15310
1.80	-1.06884	1.21110	.66717	.24756	.72170	.16880
1.90	-.95110	1.14328	.68834	.17623	.70341	.18489
2.00	-.84024	1.07370	.70249	.10718	.67659	.20130
2.10	-.73640	1.00302	.70987	.04119	.64210	.21798
2.20	-.63965	.93194	.71084	-.02101	.60093	.23486
2.30	-.55000	.86106	.70581	-.07880	.55414	.25187
2.40	-.46741	.79097	.69524	-.13168	.50286	.26895
2.50	-.39177	.72220	.67964	-.17925	.44823	.28603
2.60	-.32292	.65520	.65956	-.22125	.39141	.30302
2.70	-.26066	.59042	.63557	-.25750	.33350	.31986
2.80	-.20475	.52821	.60824	-.28795	.27556	.33645
2.90	-.15493	.46887	.57816	-.31264	.21859	.35272
3.00	-.11088	.41266	.54589	-.33173	.16347	.36856
3.10	-.07229	.35975	.51198	-.34543	.11150	.38387
3.20	-.03882	.31030	.47696	-.35405	.06189	.39850
3.30	-.01012	.26438	.44132	-.35795	.01669	.41228
3.40	.01416	.22204	.40551	-.35758	-.02407	.42500
3.50	.03439	.18327	.36903	-.35330	-.06018	.43750
3.60	.05092	.14803	.33495	-.34568	-.09166	.45000
3.70	.06410	.11625	.30089	-.33513	-.11860	.46250
3.80	.07428	.08781	.26800	-.32211	-.14113	.47500
3.90	.08172	.06260	.23653	-.30705	-.15935	.48750
4.00	.08689	.04042	.20644	-.29037	-.17379	.50000

TABLE 67. COEFFICIENTS FOR PILE WITH NEGATIVE MOMENT AT GROUND SURFACE

J = -2.00 R = 1.35 T = 3.450

βX	C_y	C_S	C_M	C_V	C_q	$K/K_{8.0}$
.00	-4.18877	1.47544	-.73772	1.00000	-.00000	-.00000
.10	-4.03770	1.54411	-.63773	.99972	.00785	.00048
.20	-3.88026	1.60288	-.53782	.99792	.03015	.00193
.30	-3.71744	1.65168	-.43823	.99328	.06444	.00433
.40	-3.55023	1.69055	-.33929	.98468	.10882	.00766
.50	-3.37963	1.71959	-.24145	.97124	.16097	.01190
.60	-3.20662	1.73890	-.14522	.95229	.21870	.01705
.70	-3.03215	1.74870	-.05118	.92737	.27987	.02307
.80	-2.85717	1.74923	.04006	.89626	.34244	.02996
.90	-2.68259	1.74081	.12788	.85890	.40468	.03769
1.00	-2.50928	1.72382	.21165	.81544	.46425	.04625
1.10	-2.33808	1.69864	.29079	.76619	.52015	.05561
1.20	-2.16979	1.66583	.36472	.71160	.57080	.06576
1.30	-2.00514	1.62590	.43296	.65226	.61581	.07667
1.40	-1.84481	1.57945	.49505	.58886	.65183	.08833
1.50	-1.68943	1.52714	.55063	.52218	.68054	.10070
1.60	-1.53955	1.46957	.59941	.45305	.70062	.11377
1.70	-1.39566	1.40749	.64119	.38237	.71180	.12750
1.80	-1.25817	1.34158	.67586	.31101	.71401	.14187
1.90	-1.12744	1.27257	.70340	.23988	.70739	.15685
2.00	-1.00373	1.20117	.72387	.16983	.69227	.17242
2.10	-.88726	1.12804	.73743	.10171	.66912	.18853
2.20	-.77816	1.05390	.74430	.03627	.63859	.20515
2.30	-.67649	.97940	.74479	-.02578	.60142	.22225
2.40	-.58227	.90516	.73927	-.08381	.55849	.23978
2.50	-.49543	.83176	.72817	-.13730	.51071	.25770
2.60	-.41588	.75971	.71196	-.18582	.45916	.27596
2.70	-.34343	.68952	.69117	-.22901	.40455	.29449
2.80	-.27790	.62162	.66633	-.26666	.34819	.31323
2.90	-.21903	.55638	.63801	-.29862	.29097	.33210
3.00	-.16653	.49412	.60679	-.32486	.23383	.35102
3.10	-.12010	.43510	.57322	-.34543	.17768	.36985
3.20	-.07940	.37954	.53787	-.36046	.12337	.38843
3.30	-.04408	.32757	.50129	-.37019	.07168	.40651
3.40	-.01377	.27930	.46399	-.37492	.02334	.42360
3.50	.01189	.23479	.42645	-.37501	-.02050	.43750
3.60	.03329	.19401	.38912	-.37094	-.05993	.45000
3.70	.05080	.15694	.35238	-.36320	-.09399	.46250
3.80	.06479	.12350	.31658	-.35231	-.12311	.47500
3.90	.07561	.09358	.28200	-.33875	-.14745	.48750
4.00	.08361	.06701	.24890	-.32300	-.16723	.50000

TABLE 68. COEFFICIENTS FOR PILE WITH NEGATIVE MOMENT AT GROUND SURFACE

J = -2.00 R = 1.05 T = 3.575

βx	C_y	C_S	C_M	C_V	C_q	$K/K_{8.0}$
.00	-4.61579	1.55775	-.77887	1.00000	-.00000	-.00000
.10	-4.45629	1.63053	-.67888	.99977	.00653	.00036
.20	-4.29000	1.69342	-.57896	.99826	.02516	.00146
.30	-4.11792	1.74633	-.47930	.99436	.05430	.00329
.40	-3.94104	1.78930	-.38019	.98709	.09273	.00585
.50	-3.76037	1.82242	-.28202	.97564	.13754	.00914
.60	-3.57687	1.84575	-.18522	.95938	.18825	.01315
.70	-3.39151	1.85951	-.09030	.93785	.24277	.01789
.80	-3.20526	1.86390	.00218	.91075	.29943	.02335
.90	-3.01902	1.85918	.09167	.87795	.35664	.02953
1.00	-2.83369	1.84571	.17759	.83946	.41292	.03643
1.10	-2.65014	1.82381	.25939	.79545	.46687	.04404
1.20	-2.46918	1.79398	.33652	.74621	.51721	.05236
1.30	-2.29158	1.75669	.40848	.69217	.56282	.06140
1.40	-2.11806	1.71248	.48482	.63385	.60275	.07114
1.50	-1.94928	1.66196	.53513	.57185	.63618	.08159
1.60	-1.78585	1.60568	.58909	.50686	.66248	.09274
1.70	-1.62830	1.54436	.63644	.43962	.68120	.10458
1.80	-1.47711	1.47864	.67697	.37090	.69205	.11712
1.90	-1.33269	1.40921	.71059	.30149	.69493	.13036
2.00	-1.19537	1.33678	.73727	.23219	.68988	.14428
2.10	-1.06541	1.26200	.75706	.16379	.67711	.15888
2.20	-.94302	1.18559	.77008	.09703	.65696	.17416
2.30	-.82832	1.10821	.77654	.03264	.62991	.19011
2.40	-.72139	1.03051	.77671	-.02873	.59654	.20673
2.50	-.62221	.95309	.77091	-.08647	.55753	.22401
2.60	-.53074	.87652	.75954	-.14006	.51363	.24193
2.70	-.44686	.80136	.74304	-.18905	.46565	.26050
2.80	-.37041	.72808	.72189	-.23308	.41443	.27970
2.90	-.30118	.65713	.69659	-.27185	.36084	.29952
3.00	-.23890	.58889	.66769	-.30519	.30575	.31995
3.10	-.18330	.52370	.63573	-.33298	.24999	.34095
3.20	-.13406	.46183	.60126	-.35520	.19439	.36251
3.30	-.09082	.40351	.56486	-.37189	.13972	.38458
3.40	-.05324	.34891	.52705	-.38320	.08670	.40710
3.50	-.02092	.29814	.48838	-.38932	.03598	.42993
3.60	.00650	.25125	.44935	-.39050	-.01170	.45000
3.70	.02944	.20826	.41042	-.38716	-.05447	.46250
3.80	.04827	.16914	.37204	-.37984	-.09172	.47500
3.90	.06339	.13382	.33457	-.36900	-.12361	.48750
4.00	.07515	.10215	.29833	-.35829	-.15031	.50000

APPENDIX O

RESULTS FOR PILES WITH J = -4.00

TABLE 69. COEFFICIENTS FOR PILE WITH NEGATIVE MOMENT AT GROUND SURFACE

$J = -4.00$ $K = (\beta x/8.0)K_{8.0}$

βx	C_y	C_S	C_M	C_V	C_q	$K/K_{8.0}$
.00	-2.92180	1.42299	-.35574	1.00000	.00000	.00000
.10	-2.77788	1.45347	-.25598	.99279	.13889	.01250
.20	-2.63141	1.47413	-.15760	.97258	.26314	.02500
.30	-2.48336	1.48508	-.06183	.94069	.37250	.03750
.40	-2.33469	1.48663	.03022	.89861	.46693	.05000
.50	-2.18632	1.47920	.11761	.84783	.54657	.06250
.60	-2.03911	1.46330	.19956	.78981	.61173	.07500
.70	-1.89390	1.43951	.27539	.72598	.66286	.08750
.80	-1.75144	1.40845	.34461	.65771	.70057	.10000
.90	-1.61241	1.37083	.40684	.58631	.72558	.11250
1.00	-1.47745	1.32734	.46182	.51301	.73872	.12500
1.10	-1.34711	1.27873	.50942	.43898	.74091	.13750
1.20	-1.22184	1.22572	.54962	.36518	.73310	.15000
1.30	-1.10207	1.16906	.58250	.29265	.71675	.16250
1.40	-.98812	1.10947	.60822	.22219	.69168	.17500
1.50	-.88025	1.04766	.62702	.15455	.66018	.18750
1.60	-.77864	.98430	.63923	.09036	.62291	.20000
1.70	-.68342	.92003	.64522	.03014	.58090	.21250
1.80	-.59464	.85546	.64540	-.02568	.53518	.22500
1.90	-.51231	.79114	.64023	-.07679	.48670	.23750
2.00	-.43639	.72759	.63020	-.12295	.43639	.25000
2.10	-.36676	.66526	.61580	-.16403	.38510	.26250
2.20	-.30328	.60456	.59755	-.19997	.33361	.27500
2.30	-.24578	.54586	.57596	-.23077	.28265	.28750
2.40	-.19404	.48947	.55155	-.25654	.23284	.30000
2.50	-.14781	.43564	.52481	-.27741	.18476	.31250
2.60	-.10682	.38457	.49622	-.29357	.13887	.32500
2.70	-.07080	.33644	.46623	-.30527	.09558	.33750
2.80	-.03944	.29136	.43529	-.31279	.05521	.35000
2.90	-.01243	.24940	.40380	-.31643	.01892	.36250
3.00	.01053	.21061	.37212	-.31651	-.01580	.37500
3.10	.02978	.17497	.34059	-.31339	-.04617	.38750
3.20	.04563	.14247	.30953	-.30741	-.07311	.40000
3.30	.05838	.11304	.27919	-.29891	-.09632	.41250
3.40	.06833	.08660	.24981	-.28826	-.11617	.42500
3.50	.07579	.06304	.22159	-.27580	-.13263	.43750
3.60	.08103	.04223	.19470	-.26185	-.14585	.45000
3.70	.08432	.02405	.16926	-.24674	-.15599	.46250
3.80	.08591	.00833	.14538	-.23075	-.16324	.47500
3.90	.08605	-.00508	.12312	-.21418	-.16781	.48750
4.00	.08496	-.01637	.10255	-.19728	-.16993	.50000

TABLE 70. COEFFICIENTS FOR PILE WITH NEGATIVE MOMENT AT GROUND SURFACE

J = -4.00 R = 5.00 T = 3.000

βx	C_y	C_S	C_M	C_V	C_q	$K/K_{8.0}$
.00	-3.39669	1.60217	-.40054	1.00000	-.00000	-.00000
.10	-3.23464	1.63712	-.30057	.99908	.02521	.00194
.20	-3.06958	1.66219	-.20087	.99357	.08955	.00729
.30	-2.90251	1.67733	-.10209	.98031	.17829	.01535
.40	-2.73442	1.68267	-.00511	.95748	.27948	.02555
.50	-2.56627	1.67847	.08908	.92431	.38373	.03738
.60	-2.39902	1.66499	.17943	.88088	.48397	.05042
.70	-2.23355	1.64274	.26495	.82787	.57468	.06432
.80	-2.07073	1.61221	.34474	.76640	.65262	.07879
.90	-1.91135	1.57402	.41801	.69787	.71555	.09359
1.00	-1.75614	1.52887	.48414	.62386	.76244	.10853
1.10	-1.60577	1.47746	.54266	.54596	.79318	.12348
1.20	-1.46082	1.42061	.59326	.46577	.80833	.13833
1.30	-1.32179	1.35910	.63579	.38481	.80806	.15300
1.40	-1.18912	1.29374	.67024	.30444	.79646	.16744
1.50	-1.06314	1.22534	.69674	.22592	.77244	.18164
1.60	-.94412	1.15466	.71552	.15030	.73858	.19557
1.70	-.83226	1.08249	.72692	.07849	.69661	.20925
1.80	-.72765	1.00953	.73136	.01121	.64818	.22269
1.90	-.63035	.93645	.72932	-.05097	.59487	.23592
2.00	-.54035	.86388	.72133	-.10764	.53812	.24897
2.10	-.45755	.79237	.70797	-.15852	.47926	.26186
2.20	-.38182	.72245	.68981	-.20344	.41944	.27462
2.30	-.31299	.65456	.66746	-.24242	.35969	.28730
2.40	-.25083	.58908	.64152	-.27544	.30091	.29990
2.50	-.19509	.52637	.61256	-.30264	.24383	.31245
2.60	-.14547	.46666	.58116	-.32429	.18910	.32498
2.70	-.10166	.41020	.54787	-.34058	.13724	.33749
2.80	-.06332	.35713	.51320	-.35185	.08865	.34999
2.90	-.03012	.30759	.47764	-.35844	.04368	.36250
3.00	-.00169	.26162	.44165	-.36072	.00254	.37500
3.10	.02231	.21926	.40562	-.35909	-.03458	.38750
3.20	.04226	.18048	.36994	-.35395	-.06762	.40000
3.30	.05852	.14525	.33493	-.34571	-.09655	.41250
3.40	.07142	.11347	.30088	-.33478	-.12142	.42500
3.50	.08131	.08503	.26804	-.32157	-.14230	.43750
3.60	.08853	.05981	.23663	-.30646	-.15935	.45000
3.70	.09337	.03765	.20680	-.28983	-.17274	.46250
3.80	.09615	.01839	.17870	-.27203	-.18268	.47500
3.90	.09713	.00184	.15242	-.25340	-.18942	.48750
4.00	.09660	-.01219	.12803	-.23425	-.19320	.50000

TABLE 71. COEFFICIENTS FOR PILE WITH NEGATIVE MOMENT AT GROUND SURFACE

J = -4.00 R = 2.75 T = 3.100

βY	C_y	C_S	C_M	C_V	C_q	$K/K_{8.0}$
.00	-3.87454	1.75294	-.43823	1.00000	-.00000	-.00000
.10	-3.69722	1.79166	-.33825	.99943	.01593	.00107
.20	-3.51652	1.82049	-.23844	.99585	.05852	.00418
.30	-3.33343	1.83937	-.13925	.98693	.12207	.00915
.40	-3.14895	1.84838	-.04128	.97095	.199[illegible]6	.01580
.50	-2.96406	1.84771	.05469	.94683	.28418	.02396
.60	-2.77971	1.83755	.14781	.91401	.37237	.03349
.70	-2.59684	1.81826	.23721	.87240	.45927	.04421
.80	-2.41633	1.79026	.32203	.82233	.54120	.05599
.90	-2.23904	1.75405	.40144	.76444	.61520	.06869
1.00	-2.06576	1.71021	.47470	.69965	.67895	.08216
1.10	-1.89722	1.65935	.54119	.62907	.73081	.09630
1.20	-1.73408	1.60222	.60037	.55395	.76971	.11096
1.30	-1.57695	1.53955	.65187	.47561	.79514	.12605
1.40	-1.42632	1.47212	.69544	.39540	.807[illegible]8	.14146
1.50	-1.28265	1.40076	.73094	.31465	.80594	.15708
1.60	-1.14627	1.32622	.75839	.23465	.79245	.17283
1.70	-1.01747	1.24935	.77793	.15656	.76768	.18862
1.80	-.89645	1.17091	.78979	.08146	.73287	.20438
1.90	-.78332	1.09165	.79434	.01029	.68943	.22003
2.00	-.67812	1.01230	.79200	-.05617	.63887	.23552
2.10	-.58084	.93348	.78327	-.11728	.58272	.25089
2.20	-.49139	.85584	.76873	-.17257	.52251	.26583
2.30	-.40962	.77992	.74895	-.22170	.45971	.28056
2.40	-.33534	.70621	.72458	-.26447	.39569	.29498
2.50	-.26830	.63515	.69626	-.30084	.33171	.30908
2.60	-.20822	.56707	.66462	-.33085	.26889	.32284
2.70	-.15478	.50231	.63028	-.35469	.20820	.33629
2.80	-.10764	.44109	.59386	-.37260	.15046	.34943
2.90	-.06644	.38359	.55594	-.38491	.09629	.36230
3.00	-.03080	.32994	.51704	-.39200	.04620	.37497
3.10	-.00033	.28020	.47769	-.39431	.00052	.38750
3.20	.02535	.23440	.43832	-.39227	-.04056	.40000
3.30	.04666	.19252	.39935	-.38635	-.07699	.41250
3.40	.06398	.15451	.36115	-.37704	-.10876	.42500
3.50	.07768	.12026	.32404	-.36477	-.13595	.43750
3.60	.08814	.08965	.28828	-.35000	-.15846	.45000
3.70	.09572	.06254	.25410	-.33319	-.177[illegible]9	.46250
3.80	.10076	.03877	.22169	-.31473	-.19144	.47500
3.90	.10357	.01814	.19119	-.29503	-.20197	.48750
4.00	.10448	.00043	.16271	-.27447	-.20896	.50000

TABLE 72. COEFFICIENTS FOR PILE WITH NEGATIVE MOMENT AT GROUND SURFACE

J = -4.00 R = 1.80 T = 3.225

βx	C_y	C_S	C_M	C_V	C_q	$K/K_{8.0}$
.00	-4.40200	1.90311	-.47578	1.00000	-.00000	-.00000
.10	-4.20948	1.94558	-.37579	.99958	.01160	.00068
.20	-4.01319	1.97816	-.27593	.99695	.04368	.00272
.30	-3.81415	2.00078	-.17652	.99027	.09221	.00604
.40	-3.61335	2.01350	-.07805	.97807	.15326	.01060
.50	-3.41176	2.01646	.01888	.95930	.22310	.01634
.60	-3.21036	2.00980	.11358	.93326	.29821	.02322
.70	-3.01009	1.99383	.20530	.89959	.37532	.03117
.80	-2.81187	1.96888	.29326	.85823	.45148	.04014
.90	-2.61658	1.93534	.37671	.80942	.52409	.05007
1.00	-2.42506	1.89374	.45493	.75362	.59089	.06091
1.10	-2.23907	1.84457	.52724	.69151	.65000	.07260
1.20	-2.05636	1.78850	.59306	.62394	.69991	.08509
1.30	-1.88057	1.72620	.65189	.55189	.73960	.09830
1.40	-1.71129	1.65839	.70333	.47643	.76803	.11220
1.50	-1.54904	1.58583	.74710	.39860	.78508	.12670
1.60	-1.39425	1.50924	.78303	.31982	.79060	.14176
1.70	-1.24729	1.42948	.81107	.24097	.78482	.15730
1.80	-1.10843	1.34731	.83126	.16324	.76825	.17327
1.90	-.97788	1.26350	.84378	.08768	.74164	.18960
2.00	-.85576	1.17883	.84889	.01524	.70591	.20622
2.10	-.74212	1.09397	.84695	-.05322	.66217	.22306
2.20	-.63695	1.00966	.83840	-.11696	.61163	.24006
2.30	-.54015	.92651	.82373	-.17536	.55587	.25713
2.40	-.45159	.84511	.80351	-.22793	.49533	.27421
2.50	-.37106	.76599	.77834	-.27432	.43223	.29121
2.60	-.29831	.68960	.74884	-.31432	.36758	.30805
2.70	-.23304	.61635	.71568	-.34783	.30262	.32464
2.80	-.17493	.54657	.67948	-.37487	.23852	.34088
2.90	-.12361	.48054	.64090	-.39560	.17635	.35667
3.00	-.07870	.41846	.60055	-.41025	.11707	.37189
3.10	-.39794	.36047	.55903	-.41915	.61503	.38639
3.20	-.00647	.30667	.51689	-.42271	.01036	.39993
3.30	.02167	.25709	.47464	-.42140	-.03575	.41250
3.40	.04507	.21173	.43274	-.41574	-.07662	.42500
3.50	.06414	.17052	.39161	-.40626	-.11225	.43750
3.60	.07930	.13337	.35160	-.39347	-.14274	.45000
3.70	.09094	.10015	.31300	-.37788	-.16824	.46250
3.80	.09945	.07071	.27609	-.35999	-.18896	.47500
3.90	.10519	.04487	.24106	-.34025	-.20513	.48750
4.00	.10853	.02239	.20808	-.31912	-.21766	.50000

TABLE 73. COEFFICIENTS FOR PILE WITH NEGATIVE MOMENT AT GROUND SURFACE

J = -4.00 R = 1.35 T = 3.325

βx	C_y	C_S	C_M	C_V	C_q	$K/K_{8.0}$
.00	-4.86698	2.02598	-.50650	1.00000	-.00000	-.00000
.10	-4.66202	2.07153	-.40650	.99966	.00941	.00050
.20	-4.45299	2.10718	-.30662	.99752	.03577	.00200
.30	-4.24089	2.13286	-.20711	.99201	.07623	.00449
.40	-4.02672	2.14863	-.10836	.98188	.12796	.00794
.50	-3.81147	2.15460	-.01091	.96612	.18817	.01234
.60	-3.59611	2.15088	.08466	.94403	.25416	.01766
.70	-3.38159	2.13774	.17769	.91517	.32336	.02390
.80	-3.16985	2.11545	.26748	.87933	.39337	.03103
.90	-2.95878	2.08438	.35334	.83655	.46195	.03903
1.00	-2.75223	2.04497	.43458	.78706	.52711	.04788
1.10	-2.55003	1.99765	.51055	.73131	.58709	.05755
1.20	-2.35293	1.94305	.58066	.66988	.64036	.06803
1.30	-2.16163	1.88175	.64437	.60352	.68569	.07930
1.40	-1.97677	1.81442	.70124	.53306	.72210	.09132
1.50	-1.79891	1.74177	.75089	.45943	.74890	.10407
1.60	-1.62856	1.66450	.79305	.38363	.76564	.11753
1.70	-1.46613	1.58342	.82758	.30667	.77216	.13166
1.80	-1.31197	1.49926	.85438	.22956	.76852	.14644
1.90	-1.16635	1.41281	.87351	.15331	.75502	.16183
2.00	-1.02946	1.32484	.88510	.07889	.73216	.17780
2.10	-.90141	1.23605	.88938	.00719	.70062	.19431
2.20	-.78225	1.14720	.88665	-.06096	.66123	.21132
2.30	-.67195	1.05895	.87732	-.12482	.61495	.22879
2.40	-.57042	.97195	.86184	-.18374	.56281	.24666
2.50	-.47750	.88680	.84074	-.23721	.50595	.26489
2.60	-.39299	.80399	.81458	-.28481	.44552	.28341
2.70	-.31661	.72403	.78397	-.32623	.38267	.30215
2.80	-.24808	.64733	.74954	-.36130	.31857	.32103
2.90	-.18704	.57423	.71191	-.38994	.25433	.33994
3.00	-.13311	.50504	.67175	-.41220	.19102	.35875
3.10	-.08590	.43995	.62967	-.42822	.12964	.37728
3.20	-.04499	.37915	.58629	-.43823	.07112	.39523
3.30	-.00993	.32272	.54220	-.44257	.01637	.41193
3.40	.01969	.27071	.49794	-.44168	-.03347	.42500
3.50	.04434	.22312	.45401	-.43608	-.07760	.43750
3.60	.06445	.17988	.41085	-.42636	-.11601	.45000
3.70	.08045	.14091	.36885	-.41308	-.14883	.46250
3.80	.09276	.10606	.32833	-.39478	-.17625	.47500
3.90	.10179	.07518	.28957	-.37801	-.19849	.48750
4.00	.10791	.04804	.25279	-.35727	-.21583	.50000

TABLE 74. COEFFICIENTS FOR PILE WITH NEGATIVE MOMENT AT GROUND SURFACE

J = -4.00 R = 1.05 T = 3.450

βx	C_y	C_S	C_M	C_V	C_q	$K/K_{8.0}$
.00	-5.37452	2.15218	-.53805	1.00000	-.00000	-.00000
.10	-5.15678	2.20088	-.43805	.99972	.00784	.00038
.20	-4.93466	2.23969	-.33815	.99792	.02999	.00151
.30	-4.70915	2.26852	-.23856	.99329	.06435	.00341
.40	-4.48126	2.28742	-.13961	.98470	.10878	.00606
.50	-4.25197	2.29650	-.04177	.97125	.16114	.00947
.60	-4.02227	2.29583	.05446	.95226	.21933	.01363
.70	-3.79310	2.28567	.14850	.92725	.28129	.01853
.80	-3.56542	2.26623	.23972	.89594	.34506	.02419
.90	-3.34014	2.23785	.32748	.85824	.40876	.03059
1.00	-3.11812	2.20090	.41117	.81425	.47068	.03773
1.10	-2.90022	2.15578	.49014	.76422	.52924	.04562
1.20	-2.68720	2.10304	.56383	.70857	.58304	.05424
1.30	-2.47983	2.04322	.63170	.64783	.63085	.06359
1.40	-2.27876	1.97692	.69326	.58265	.67165	.07368
1.50	-2.08462	1.90482	.74811	.51377	.70462	.08450
1.60	-1.89796	1.82755	.79593	.44202	.72915	.09604
1.70	-1.71925	1.74588	.83645	.36826	.74483	.10830
1.80	-1.54890	1.66052	.86954	.29338	.75145	.12128
1.90	-1.38724	1.57224	.89512	.21829	.74900	.13498
2.00	-1.23452	1.48178	.91322	.14389	.73767	.14938
2.10	-1.09093	1.38985	.92395	.07105	.71779	.16449
2.20	-.95657	1.29723	.92751	.00062	.68986	.18029
2.30	-.83149	1.20460	.92417	-.06665	.65451	.19678
2.40	-.71563	1.11263	.91430	-.13005	.61249	.21396
2.50	-.60892	1.02197	.89830	-.18895	.56465	.23182
2.60	-.51118	.93317	.87667	-.24281	.51189	.25034
2.70	-.42221	.84680	.84991	-.29119	.45518	.26952
2.80	-.34173	.76335	.81861	-.33374	.39550	.28933
2.90	-.26944	.68322	.78336	-.37022	.33386	.30977
3.00	-.20497	.60680	.74476	-.40048	.27124	.33082
3.10	-.14795	.53436	.70346	-.42447	.20858	.35243
3.20	-.09797	.46618	.66006	-.44222	.14679	.37457
3.30	-.05458	.40240	.61520	-.45389	.08671	.39716
3.40	-.01734	.34317	.56947	-.45966	.02914	.42001
3.50	.01419	.28853	.52345	-.45984	-.02483	.43750
3.60	.04050	.23847	.47766	-.45490	-.07290	.45000
3.70	.06203	.19296	.43261	-.44548	-.11475	.46250
3.80	.07923	.15191	.38869	-.43217	-.15054	.47500
3.90	.09254	.11517	.34628	-.41557	-.18046	.48750
4.00	.10239	.08255	.30566	-.39629	-.20479	.50000

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Wallace Estill Wilson was born on July 8, 1935, in Nashville, Tennessee, the son of Mr. and Mrs. Buford Gray Wilson. He attended Stokes Elementary School and Montgomery Bell Academy, both in Nashville, and graduated from the latter in July, 1953.

In September, 1953, Mr. Wilson entered Vanderbilt University, where he studied Civil Engineering. He received a Bachelor of Engineering degree in June, 1957, graduating *magna cum laude*. In September, 1957, he entered the Civil Engineering graduate school at Lehigh University and received a Master of Science degree from that school in June, 1958.

He was a structural engineer with Ross H. Bryan, Consulting Engineers, in Nashville, Tennessee, from June, 1958, to March, 1960. From March, 1960, to July, 1960, he was on active duty with the United States Navy Reserve. Afterwards he was with Ross H. Bryan briefly before coming to the Georgia Institute of Technology in September, 1960.

Mr. Wilson spent most of the period of time from September, 1960, until July, 1965, at Georgia Tech as a graduate student, teaching assistant, and research assistant. He spent the summer of 1962 with the Humble Oil Company in New Orleans, Louisiana, as a structural consultant.

In July, 1965, he joined the Eastern Engineering Company in Atlanta, Georgia, as a structural engineer and is still employed there.